ENGINEERING NEWS

At a meeting this week of the Croton Aqueduct Commissioners, the Board of Engineers, appointed in April last to consider the plans of the Quaker Bridge dam were requested to report by July 11, or as soon thereafter as practicable, and the Chief Engineer to be prepared to take speedy steps toward advertising for bids for the work. There is certainly the most urgent need for the speedy beginning of work on the dam, which must take some years to build at best, but it is hardly right that a Board of Engineers considering so important a matter as the proper design of the dam, should not take all the time they felt to be necessary to reach positive conclusions, nor do we presume they have or will do so.

MESSRS. H. C. LITCHFIELD, assistant engineer, and H. D. MURPHY, artist, of the Nicaragua Canal Survey Expedition, have arrived home, and bring news from the expedition to June 11. All were well, and the surveys were practically finished and very satisfactory. Chief Engineer MENOCAL had arrived at the headquarters, on the San Juan, from his visit to the west side. The location of the lower route had already been completed from Ochoa to Greytown, except some local examinations and borings which Mr. PEARY had directed to be made.

The distances of the final location of the upper route, which is the one which seems decidedly the best, and will probably be adopted, were as follows. We add for comparison the corresponding distances by the survey of 1885:

	Survey of 1885.			Survey of 1888.		
	Can'l	Free Nav.	Tot.	Can'l	Free Nav.	Tot.
Western Division.....	17.27	00	17.27	12.14	4.83	16.97
Lake Nicaragua	00	56.50	56.50	00	56.50	56.50
San Juan riv.	00	64.54	64.54	00	64.54	64.54
San Francisco basin	3.00	9.01	12.01	2.07	1.45 9.04	12.56
Great Divide Cut.	3.00	00	3.00	3.03	.00	3.03
Divide cut to Greytown..	16.48	00	16.48	12.95	3.40	16.35
Total.	39.75	130.05	169.80	30.19	139.76	169.95

THE principal changes, and decidedly important ones, are the substitution of 4.83 miles on the western division, 1.45 miles on the middle division, and 3.40 miles on the eastern division, or 9.68 miles in all, of free slack-water navigation in basins produced by dams, for equal lengths of canal in excavation. This not only gives less cost and simplifies construction, but gives much freer and safer navigation, both because of the greater depth and the greater width. The possibility of doing this has been suggested before, and is apparent from the maps, but it had not been definitely determined.

The canal project now includes only 30.19 miles of canal excavation proper, only 3.03 miles of deep excavation, and only about 8 miles more of excavation averaging over 20 ft. deeper than the canal prism of 30 ft. The route is a wonderfully favorable one and has been very skilfully studied.

THE total length of the embankment for impounding the waters of the San Francisco will be about 4,362 ft. divided into ten different embankments of varying lengths, as against 6,550 ft. in one embankment estimated in 1885. The length of waste-weirs proposed is included in the total of 4,362 ft. Where the hills do not reach the necessary height for the confining basin, their summits will be raised by means of embankments which may necessitate a total length on the crests and ridges of 15,000 ft. This work involves neither engineering difficulties nor considerable expense, but the necessity was not determined in the former surveys.

THE latest reports from Panama, of date June 16, are that every energy is now directed toward putting in the locks, leaving other work and other questions in abeyance. The correspondent of the New York *Times* says:

"I have been on the line of the canal again and again since the construction of the locks began. This is what I have seen—that almost everything else has been abandoned and all energy concentrated on the locks. There is a vast amount still to be done outside of these temporary contrivances."

This seems to indicate that the real intention is to let the Chagres problem "slide", and concentrate all work on the canal proper, until the latest possible date, with the idea that, whatever new necessities may be revealed when that problem is seriously attacked, there will then be a better chance to raise the money.

THE *Journal Des Débats* says the exact result of the subscriptions to the Panama Lottery Loan is not yet known, but it is believed that the amount of applications will equal only about one-half the sum asked for. The Bourse was correspondingly agitated. There were large sales of all kinds of securities. Three per cent. rents for money declined 30 cts.; Panama Canal, 37 francs; and other securities 6 to 8 francs, but there was a recovery next day.

The Panama *Star and Herald*, remarks:

"The locks which are being constructed on the Panama canal are not designed to be a permanent feature of the canal, but have been adopted through the necessities of completing the work and opening up the canal within the required time. These locks, then, are temporary arrangements, which will be removed as soon after the opening of the canal, as can be conveniently done. The building of these locks requires the outlay of prodigious sums of money, but this immense expenditure cannot be now avoided.

"For the excavation of all the locks there will have to be removed, according to estimates, 1,200,000 or 1,300,000 cu. meters, of which on April 25, there had been about 240,000 meters removed."

OUR latest information is that "there is no question at all" about the construction of the Chignecto ship railway in Nova Scotia, and, as it is the pioneer ship railway of modern times (there were some small affairs of old) we shall endeavor to follow it closely, and to describe and illustrate it as the work goes on. While it is short and will not carry very large vessels, all the conditions are comparatively difficult especially in the high tides, so that it will be an excellent place to demonstrate the practicability, both constructively and commercially, of ship railways for inter-ocean ship transportation; and should it be successful, it would be likely to greatly help toward the building of the Tehuantepec Ship Railway, and perhaps to the building of a Florida ship railway and Georgian Bay-Toronto ship railway likewise. We have never been able to see why the project should not be entirely successful if properly worked out.

The line is about 17½ miles long, straight from end to end, with the very favorable grades of 0.2 per cent, or 10.56 ft. per mile. There are to be 40 ft. hydraulic lifts at each end of a capacity of 2,000 tons, to take a vessel 250 ft. long and up to 60 ft. wide.

The use of the canal will save from 500 to 700 miles of a dangerous coast from the St. Lawrence and Gulf ports on the east, to St. John N. B. and other ports to the west and south.

It is estimated that fully 600,000 tons of merchandise would be carried over the road annually, requiring an equal amount of registered tonnage to carry it, and that a fair rate of tolls would be 50 cts. for cargo and 10 cts. per ton for vessel. The revenue would therefore be on this basis 600,000 tons at 60 cts. = $360,000. And it is estimated that 30 per cent. of this would cover working expenses. The railway would be in operation from 7 to 8 months in the year only. And a further revenue may be derived from its use in winter time for the repair of vessels requiring to be raised out of the water. The Dominion Government is to grant it an annual subsidy of $170,000 for 20 years.

THE House of Commons has rejected the Channel tunnel bill by 307 to 165, which is a rather hopeless looking vote, but about twice as near to authorization as the scheme has ever come before

THE most serious railway accident of the week was the ditching on June 23 of the "Thunderbolt", the west-bound passenger train of the New York, Lake Erie & Western Railroad, on account of a misplaced switch at Whitehouse, three miles from Cuba, N. Y. The engineer was killed, and the fireman, a brakeman and two passengers were badly injured. It is thought that the switch was wilfully misplaced, as the target was set right for the main track and the lock had evidently been tampered with.——The collision of a freight and a coal train on the Pennsylvania Railroad near Schuylkill Haven, Pa., on June 22, resulted in the death of the engineer and the fatal injury of the fireman and one other man.——June 14, an excursion train was derailed near Braddock, Kan., on the Santa Fé road, and about fifteen persons injured.——Six laborers were killed and four fatally injured in a wreck on the Pennsylvania, Schuylkill Valley Railroad, at Cable City, Pa., June 25. A freight train collided with a gravel train, burying the men in the debris.

THE following bridge accidents are reported. A bridge over the Mad river near Springfield, O., was burned June 25. The Bee Line trains are now running over the N. Y. P. & O. line, *via* Enon. It will require about three weeks to replace the bridge ——The approaches to the Kansas Avenue bridge Carondelet, Mo., have been seriously damaged by storms.——June 22, at Dugan's stone quarry, near Nevada, Mo., on the Nevada & Meriden Branch Railroad, an engine and caboose were being backed across a large trestle, when the tender left the track and the trestle fell. It is *reported* that the rails hung together and held the locomotive and caboose suspended in mid air.——One span of the Green Bay Railroad bridge at Grand Rapids, Mich., was taken out by a gale June 20.——The south bound passenger train from Montgomery to Mobile, went through a small bridge a mile north of Tensas Ala., June 27, killing the engineer, fireman and two tramps, and dangerously injuring some others.

A WASHOUT at Dayton, Tex., caused by a rise in the Trinity river has delayed trains on the Southern Pacific Railroad during the last week.——A bridge on the Caseyville road near St. Louis was washed away by a recent storm.——A bridge over Castle creek near Redding, Cal., was swept away by a flood June 14.

TERRIFIC washouts have occurred in Mexico all along the line of the Mexican Central Railway in South Central Mexico, the worst effect having been at the city of Leon, where great numbers of adobe houses were washed down, causing the loss of fully 1,500 lives, and perhaps many more, over 1,000 bodies having been already recovered. The circumstances are such as to require more extended description than we can give in a news note to have them fully comprehended, and as they are of technical interest in several respects, we shall describe them more fully next week, only adding now that such a storm is without precedent for three centuries, and that it seems to afford some support for the belief current in Mexico that the railways are having a modifying effect upon the rainfall.

A CURIOUS wreck occurred at Amsterdam, on the New York Central Railroad on the 21st inst. due directly to the use of train brakes, illustrating that the best device cannot always under all conditions give safety, but may even cause danger. Part of a freight train, the first 6 cars, were equipped with the Westinghouse automatic brake. Behind these were 16 empty cars, and behind them 21 loaded cars. A hose burst on the braked cars and of course instantly put on the brakes. Had the air brakes been on all or half of the cars, all would have been well; but being on only a few, with a heavy unbraked train behind, and the brakes going on with maximum force from the breaking of the hose, the rear cars crowded up with such force as to cause a bad derailment and general smash-up. No one was injured, but the track was blocked for nearly three hours.

THE contemplated bridge over the Mississippi at Memphis, Tenn. ought, in the opinion of prominent steamboat men who have been expressing their views in the newspapers, to have a span of at least 1,000 ft. near the Memphis shore and 85 ft. above high water mark, to prevent its interference with navigation.

THE bridge connection of the Kings County "L" road is being pushed forward and it is expected that it will be completed by August 1. A covered walk to be used only by passengers from New York is being erected between the station opposite No. 21 Fulton St. and the bridge platform. Passengers for New York will have to reach the bridge by way of Sands St.

The Serious Financial Condition of the Chicago, Rock Island & Pacific.

Eastern financial circles have had another proof of the alarming condition into which Western railway properties have fallen by the result of a close analysis of the last annual report of the Chicago Rock Island & Pacific Railroad Co., which has been made by Mr. W. H. WOODS of 84 Broadway, New York City. Mr. WOODS was employed by one of the principal banking houses of New York to make a careful examination and report upon the financial condition and prospects of the company. His report revealed such a state of affairs that he was requested to make a supplemental report based upon the figures given in the annual report of the company, dated April 1. In this report, which has just been made public, Mr. WOODS says:

"As requested, I am now able to supplement the report made to you in March last, and I will preface it by saying that it is now clear that overbuilding, reckless competition, and Grangerism have at last about wrecked the Rock Island Road. It is sad reading to the holders of the capital stock of this once valuable property to be told that they are on the eve of a stoppage of dividends; but such I believe is the case. I feel certain the Directors feel deeply grieved over the condition of the company, for it is a board that has always treated the stockholders fairly and liberally. Indeed, it is because they have been so liberal that the company will now have to stop paying dividends. I think the board makes a mistake by not issuing to the stockholders a frank statement of the company's condition and needs, but I suppose they dislike to face the demoralization it would cause.

"A careful analysis of the report just issued for the fiscal year ending March 31, 1888, shows that the actual net earnings were only 3.68 per cent. on the $46,152,800 of capital stock, after the payment of fixed charges; and yet 7 per cent. in cash dividends was paid to stockholders. It is true that $844,000 for premiums on 5 per cent. bonds sold, and $220,000 for receipts from land sales were added to the income, but neither item has any bearing whatever on the net earnings of property, nor should either be counted in a statement of that kind. The plain statement of net earnings and fixed charges for the year is as follows:

Net earnings over operating expenses.....		$4,767,607.34
Interest received from proprietary roads....		193,170.37
Total net income from all lines.....		$4,960,837.71
The actual fixed charges were:		
Interest paid on bonded debt....	$1,810,777.78	
Rentals of leased lines..... ..	411,400.50	
Bridge rentals and tolls.....	206,387.78	
Equipment and repairs	833,377.56	3,261,943.71
Net for stock (3.68-100 on $46,152,800.		$1,698,894.00

"The charge of $833,377.56 for equipment and repairs is less than it should have been to keep the road in good condition, because for the past seven years this charge has averaged over $1,000,000 per annum, and is just as much a fixed charge on net earnings as interest on the bonded debt.

"A startling exhibit of the report is, that notwithstanding the company received $4,196,000 in cash for 41,-960 shares of capital stock sold last September at par, and the $1,064,000 in cash for premiums on bonds and land sales, yet on March 31, 1888, the cash and cash items were $1,536,291 less than a year ago, and the floating debt had increased $1,165,350. Since April 1 last the company has paid $982,628.50 in cash for interest and dividend; on July 1, $992,000 must be paid for interest alone, and on Aug. 1 $692,282 for the 1½ per cent. dividend just declared.

"For the new fiscal year the first quarter is now almost finished, and the loss in net earnings as compared with last year is simply fearful. With the beginning of the second quarter the new Iowa law goes into effect, and of 1,527 miles of road 1,065 are in that State. Even if the crops along the lines of road should prove as good as they now promise, no conservative friend of the property will estimate the net earnings for the year at over $4,250,000, including interest likely to be received from proprietary roads, and with this estimate the result for the year will be as follows:

Total net income from all lines estimated....		$4,250,000
The fixed charges will be:		
Interest on bonded debt,.....	$2,298,000	
Rentals and bridge tolls, (same as last year).....	617,000	
Equipment and repairs, (same as last year),.....	833,000	3,748,000
Net for $46,152,800 of stocks.....		$502,000

"If more of the 5 per cent. bonds should be issued during the year, of course the interest charge would be increased.

"The conclusions to be drawn from the above are that no dividends should have been paid for the past year, but the $3,010,518 so paid out should have been reserved to meet the pressing emergency that the company now has to face. Also, that if there is no backset to the crops, if rates should go no lower, and if the amount spent for equipment and repairs should be kept down as low as last year, then probably 1 per cent. can be earned on the stock after the payment of fixed charges.

"If, however, a disaster of any kind should come, or should the same amount be spent for equipment and repairs as has been required for the past seven years to keep the property in good condition, then the road will fail to pay its fixed charges.

"I don't hesitate to express the opinion that, with the dividend declared yesterday, you have seen the last dividend on Rock Island that you will see for a long time. I can but express surprise that it was declared by a board composed of such able men, but it may have been done to avoid the necessity, for the present, at least, of the New England savings banks' selling the securities of a road unable to pay dividends.

"It will be a sad, sad thing to see the old Rock Island join the group of non-dividend-paying stocks, but the Directors and stockholders are now brought face to face with it. It is not a question of dividend any longer with the Directors; the vital question with them from now on will be to provide for the fixed charges.

"With this plain statement of facts, is there any wonder that parties who have heretofore been friends of the property have sold out their holdings, because they believe that in less than a year the stock will sell below $50 per share, and the Rock Island 5s under 85? Fifty for the stock, however, is equal to par for original holders, because, you will remember, the stock was doubled some years ago. I beg to state that there is not a figure in the above report but what is official, except the estimate of income for the new fiscal year."

In an interview Mr. WOODS gave the following graphic description of the state of affairs on the Western roads.

I feel satisfied that very few of the Rock Island stockholders and bondholders have any idea of the condition of the property—in fact, from what I hear I am inclined to believe that some of the Directors are really ignorant of its condition. My main reason in making my report public was to show to the owners of granger stocks and bonds generally, to what straits their properties have been brought by overbuilding, granger laws, communistic railroad commissions, and the everlasting, fool-hardy rate cutting by general managers.

"Just think of it—in only four systems of the Granger roads—Northwest, Burlington, Rock Island, and St. Paul—about $700,000,000 are invested, owned mostly here in the East and in Europe, and this vast sum is to-day absolutely at the mercy of reckless and, in some cases, speculating managers, demagogues in Legislatures, and generally old played out politicians, composing the State Railroad Commissions, who know little and care less about the needs of the roads, but who think it will make them popular with the masses to 'put the screws on' in every way they can.

"At last the inevitable result is at hand, for it looks clear to me that Rock Island and St. Paul have tumbled over the precipice as dividend earners, Burlington is trembling on the brink, and stanch and well-managed Northwest is getting near dangerous ground—I say near dangerous ground, because of the statement of its business for the past five months.

The Manchester Ship Canal.

Engineering is now publishing a series of articles describing, in detail, the progress made and the methods employed on this great work, which is one of the most important and extensive engineering works now being executed, and as such may be watched with much interest by engineers all over the world. We therefore abstract very fully from *Engineering*, confining ourselves, however, to the facts of permanent interest, and omitting many details of minor importance, or merely relating to the present status of the work:

The total length of the canal is a little more than 35 miles. For convenience of management the line is divided into nine sections, each in charge of an agent and each separately equipped with an organized staff, work-shop, plant and other requirements, as if it were a separate contract. The chief engineer of the canal company's staff is Mr. E. LEADER WILLIAMS, and his principal assistant Mr. W. HENRY HUNTER. The contractor is Mr. T. A. WALKER, and his manager is Mr. W. H. TOPHAM.

SECTION NO. 1.

Section No. 1 extends from 0. m. to 4¼ m. The contractor's staff consists of an agent, sub-agent, engineer, assistant engineer, two draughtsmen, a pay clerk, two assistants, four time keepers one walking gauger and two sub-gaugers. The number of men employed on this section is about 1,400. An engineer and an assistant look after the canal company's interests.

About 300 acres of land were required to carry out the canal works on this section, to provide for the embankments, land works, etc.; and an additional 20 acres has been turned over to the contractor for the erection of offices, huts and workshops.

Work on Section 1 was begun about the first of the year. At the end of May 700,000 cu. yds. of soft material, and 20,000 cu. yds. of rock had been excavated, and the present daily average is 10 000 cu. yds. soft and 1,000 cu. yds. of rock excavation. Work is carried on night and day. Of the 5,000,000 cu. yds. of excavation which this section contains, the borings show that about 1,000,000 cu. yds. is rock. The first cutting is made from 100 ft. to 200 ft. wide, and from 12 ft. to 16 ft. deep.

"Several of RUSTON & PROCTOR'S steam navvies and one of J. & W. WILSON'S steam crane excavators are at work stripping the clay from the rock, the surface soil to a depth of about 18 ins. having been previously stripped by hand labor and put aside for subsequent use in soiling spoil banks. The steam navvies on this section have buckets holding 1⅛ cu. yds., and three scoops fill each wagon. The wagons are worked by two horses from the center road to the side roads under the bucket of the steam navvy, from whence they are picked up by an engine and run to the spoil bank. Where the rock permits, stripping to an average depth of about 12 ft. varying in width up to 200 ft. is carried through the whole length; this work is being done by steam navvies, after the first 6 ins. or 9 ins. of soil have been removed by hand. Through this cutting and below the present bottom a gullet, about 10 ft. deep and 20 ft. wide, is being carried through the rock by hand labor. The rock is red sandstone, which hardens rapidly on exposure, and gunpowder is used for blasting it out. The stuff from this excavation when blown out is loaded into skips of 1 cu. yd. capacity, and lifted into the wagons by steam cranes running on a line of rails parallel with the edge of the gullet; the large stones are saved for pitching the adjacent sea wall, and these are at once dressed with stone picks."

The nature of the soil in the cuttings is generally a gray sandy earth for about 3 ft., then stiff brown clay for 10 ft. or 12 ft. to the red sandstone. No pumping has been required as yet, but arrangements for draining the whole section have been made.

A water course which crosses the line is carried under it by means of a syphon, which, under the canal, will be 6 ft. by 6 ft. and have vertical side walls. A temporary road has been laid along the whole section, which for some distance runs along the shore of the estuary just above high-water mark. All the roads on this and other sections are of a very substantial character, being laid with 56-lb. rails, Vignoles section, spiked with four dogs to 9-ft. ties, 10 ins. × 5 ins., of which there are 2,000 to the mile. The wagons used are end and side tips and have wrought-iron wheels with steel ties. They are called 4½ yd. wagons, but their water-level capacity is 4¼ cu. yds., and the amount they actually contain varies greatly with the character of the material.

"The buildings in the Eastham yard consist of an engine shed to hold twelve engines, a carpenters' shop, a fitters' shop with lathe, planing machine, etc., a blacksmiths' shop, four fires and one 7 cwt. steam hammer, a large cement shed, a store, and a sawmill. To accommodate the labor employed on the section, there are seventy substantially built huts, each capable of holding eight lodgers over and above the family catering for them; there is one large barrack to hold 50 lodgers. There is a well in Eastham yard from which the supply of water for the section is obtained; a pumping engine is fixed at the well and the water raised to tanks built on trestles about 20 ft. high; from these tanks water is supplied by gravitation over the whole section.

"There is but little contract work going on on this length; the soil-stripping is let by contract, also the tipping on the spoil banks, but for the main work carried out by machinery, the contractor employs day labor; however, a bonus is paid to the workmen at each excavator, so much per wagon when the number exceeds a fixed quantity, so the system in a measure approaches contract labor. The steam navvies used are the ordinary type, Dunbar & Ruston's patent, built by Ruston & Proctor, and of 10 horse-power. The Wilson excavator is an ordinary 10-ton steam crane with a jib about 35 ft. long; midway on this, is fixed a frame carrying the bucket (of 1⅛ cu. yds. capacity), the lift of the bucket being from the chain over the jib, and the racking motion is obtained from a steam cylinder fixed in the frame, the piston of which is connected with the bucket; the steam is admitted to the cylinder by a flexible pipe. The makers of this machine are not giving their excavator a fair chance, for they have attached to it a bucket of such peculiar construction that it seldom entirely clears itself; this prevents just comparison with other steam excavators. The Wells light used on the section is an illuminant akin to the "Lucigen" light, but instead of a steam pipe connected with the oil drum it has a small hand air-compressor; this pump must be attended to occasionally; the pressure when renewed is 20 lbs. to the inch, which gradually falls to about 5 lbs., then it must be again

raised. The jet of light is delivered horizontally and has a wind screen fixed to prevent the flame being blown out.

"The important plant at present on this length consists of 14 locomotives with from 10 in. to 15 in. cylinders, 9 Ruston & Proctor's 10 horse-power steam navvies with 1½ yard buckets, one Wilson steam-crane excavator 1½-yard bucket, one 10-ton, one 5-ton, and seven 2½-ton steam traveling cranes, 270 wagons, and 500 wheelbarrows. On the temporary road there is one short trestle bridge and there are 14 miles of road on the section."

SECTION No. 2

The section has a length of four miles extending from 4¼ miles to 8¼ miles. About 700 men are employed, the supervising staff corresponding to that of section No. 1. A total of 311 acres of land were found necessary for the canal work, and in addition to this the contractor rents 45 acres for huts, workshops, etc.

"On section No. 2 there is, in round numbers, 3,500,000 cu. yds. of earthwork, of which about 500,000 is estimated, by the result of the borings, to be rock. There are nearly 2¾ miles of embankment to build, for along a great part of the length the riverward side of the canal will be inside the Mersey foreshore. At 5¼ miles there will be some large syphon work and river diversion, as here Thornton Brook is diverted into the River Gowie, and both are to be carried through the same syphon under the bed of the canal. A stream at 7¾ miles is also to be syphoned under the canal."

"The material is a wet peaty top soil to a depth of about 7 ft. or 8 ft., overlying greasy blue clay; abominable stuff to shift and smelling vilely. Two of Ruston & Proctor's steam navvies, with 1¼ yard buckets, are working in the face at a depth of about 14 ft. The bottom is so soft as to necessitate using close sleepers, laid to touch each other, to prevent the excavators, horses, and roads going out of sight. On surface roads parallel with the line of cutting, two Priestman's grab excavators are working, taking off the batters to prevent them slipping in on the steam navvies. At 5 m. a sump 12 ft. by 12 ft. is being sunk in the 50 ft. cess outside the canal to below its permanent depth; a drive will then be made to tap the bottom and drain this end of the section. The drainage will no doubt facilitate work in the cutting just referred to, but the peat and clay hold water very much at present, and are bad standing stuff. At 5¾ m. the large cutting for the diversion of Thornton Brook into the River Gowie is being done by hand labor, barrow hoists being fixed about 80 or 90 yds. apart; the soil cut through is peat with clay bottom. Cutting No. 9 is being opened out from about 6¾ m. to about 7¼ m. running from the surface down to about a 14 ft. face; the cutting had been flooded, and one of the steam navvies was at a standstill, the roads leading to it being buried deep in the mud. A temporary sump was sunk and drains were made to it; a 6 in. centrifugal pump threw out to the full size of the discharge a column of liquid mud doing its work splendidly and reducing a quagmire to workable ground. The material of the cutting seems to be an old deposit of river mud overlying rock. The rock shows just below the present bottom. Soil stripping of the surface of the cuttings is being carried out by hand labor almost all over the section. A temporary road is laid almost the entire length of this division; at about 6 miles, for a distance of 200 or 300 yds. this road is covered at high tides. For the crossing of the River Gowie there is a trestle bridge about 220 ft. long, with a 12 ft. clear headway above high water; at low water the structure stands quite 24 ft. above the river bottom. The section is supplied with water from an old well here; it is pumped into two tanks raised about 10 ft., and runs by gravitation to any point on the length.

"The sub-contract work on this section is at present confined to excavation for river diversions, soil stripping to a depth of about 9 ins. over the surface of the cuttings, some small lots of barrow work, and tipping the wagons on spoil banks; in addition, there is the bonus system for large outputs from the steam navvies and the grab excavators. So far, there has been no night work on this section.

"A list of the principal plant on the length is as follows: 10 locomotive engines with from 10-in. to 13-in. cylinders; 7 Ruston & Proctor's 10 H. P. steam navvies, with 1¼-yd. buckets (some 2¼ yd. buckets are on order); 2 Priestman's grab excavators, each equal in power to a 3-ton crane; one 10-ton and five 2½-ton steam traveling cranes; one 16, two 12, and one 100 H. P. portable engines; 280 wagons, and 600 wheelbarrows."

SECTION No. 3.

This division of 3¼ miles extends from 8¼ miles to 11¼ miles. At present only 300 men and the usual supervising staff are employed, but the force is to be increased. More than 372 acres of land have been placed at the disposal of the contractor.

"The work on this section will be of a highly interesting character, for more than half the distance the canal will lie within the bed of the Mersey, in places inside the deep-water channel. The Weaver Navigation discharges into the Mersey midway on the section, and to provide for its surplus waters, it is arranged that they flow into the canal, the overflow to pass off through a system of sluices to be constructed in the estuary wall or canal embankment, opposite to the Weaver mouth: the discharging capacity of the sluices will be about 320 ft. Preparations are being made to build a temporary coffer-dam, inside which the permanent sluices are to be constructed. The work of this coffer dam will be of an exceptionally heavy nature, necessitating an expenditure which can hardly fall short of between $50,000 and $60,000."

Locks will be required at 11¼ miles for the passage of the traffic of two canals. The earthwork of the section amounts to 3,189,746 cu. yds., of which a little less than 200,000 cu. yds. are estimated to be rock. So far the excavation has been limited to stripping the top soil to a depth of 3 ft. by hand, and wheeling the stuff to form an embankment against high water springs.

"The important plant on the length consists of one 10-ton steam traveling crane with 70 ft. jib, and one 5-ton fast traveling crane, one 16 horse-power portable engine, one 9 ft. mortar mill, a saw bench for one saw, one steam pile engine with 21 cwt. monkey, two barges 63 ft. long and 14 ft. beam, four small boats for crossing Weaver mouth, etc., 350 wheelbarrows, and about 60 standards of deals. There are 1½ miles of temporary roads on the section, and stacked on the ground near the site of the cofferdam for the Weaver mouth sluices there are about 2500 pine baulks, 12 in. by 12 in., and averaging about 30 feet in length. Some ships were moored in the Weaver Navigation, and from these the big crane with the 70 foot jib was rapidly adding to the stack of baulks for the cofferdam.

[TO BE CONTINUED.]

Nominal Horse Power.

Any movement toward attaching a definite meaning to technical terms in general use deserves a hearty welcome, and we gladly present herewith an abstract of an article in *The Practical Engineer* in which a praiseworthy attempt is made to clear away some of the ambiguity that has frequently made this commonly used term a very misleading one.

"Nominal Horse-power" is a term used to give an approximate idea of the commercial value of an engine, but has no fixed relation to either the actual or indicated horse-power exerted, but is essentially a conventional term, and is frequently determined simply from the size of the cylinders, leaving out of the question such variable factors as steam pressure, speed, etc. As no universal rule has ever been adopted, and as each maker has his own method of computation, the greatest differences in the calculated N. H. P's of different engines of the same power may often be found.

In marine practice a common rule for compound engines is to allow 30 circular inches of cylinder per N. H. P.

That is:

$$N.\ H.\ P. = \frac{d^2 + D^2}{30}$$

Where d = diameter high pressure cylinder, and D = diameter low pressure cylinder.

If the other factors affecting the power developed depended on the diameter of the cylinder, this rule would be a fair one. But it is evidently misleading as it stands, for two engines may have the same cylinder diameter but very different cylinder lengths. By introducing another factor, the piston speed, we might get a closer approximation; but the piston speed depends upon the supply of steam, and, therefore if we want a close approximation we must base our estimate upon the boiler capacity, as well as upon that of the engine.

A modern writer has given the following rule for finding the "estimated" horse-power of compound marine engines:

$$E.\ H.\ P. = \frac{D^2 \times \sqrt{p} \times R \times S}{8{,}500}$$

Where:

D = diameter low pressure cylinder.
p = boiler pressure.
R = number of revolutions per minute.
S = stroke of piston in feet.

This formula is evidently nothing but a means of approximating the indicated horse-power of the engine; but it certainly is a much more reliable criterion of the commercial value of the engine than the N. H. P. calculated from the cylinder diameter would have been.

The need of some universal formula which will give an idea of the commercial value and also of the real capability of the type of engine, is becoming more pressing, now that the triple expansion engine, with its high pressure and speed is so rapidly coming into prominence. Also, the fact that certain charges made against ships are based upon the registered nominal horse-power of their engines makes some means of determing this function a necessity. A rule that seems to meet all the requirements was proposed by Mr. MACFARLANE GRAY, and is as follows:

$$N.\ H.\ P. = \tfrac{1}{3}\left(\frac{D^2 \times S}{630} + F\right)$$

Where:

D = diameter low pressure cylinder in inches.
S = stroke of piston in inches.
F = total width of fire grate in inches.
630 = a constant.

It is true that the result obtained by the use of this formula is the nominal horse-power of the boiler and engine combined; but they are so mutually dependent that no accurate idea of the value of the engine can be obtained without considering the capability of the boiler.

THE following figures vividly illustrate the phenomenal growth of Chicago. The following table shows the shipments of cereals by decades:—

	Bushels.
1838	78
1848	3,001,740
1858	20,587,189
1868	63,588,358
1878	118,675,499
1887	151,868,224

The total number of hogs packed in Chicago and the rest of the country has been as follows:

	Chicago.	Rest of the West.
1854	52,849	2,534,770
1874	1,826,599	6,525,616
1887	3,851,189	12,074,274

The receipts and shipments of cattle and hogs for 20 years by decades are below:

Cattle	Received.	Shipped.
1867	329,243	216,982
1877	1,033,151	703,402
1887	2,382,008	791,483
Hogs.	**Received.**	**Shipped.**
1867	1,987,120	916,638
1877	4,190,369	1,211,289
1887	5,483,652	1,950,990

The direct exports to Europe from Chicago have grown from 8,912 tons in 1865, to 219,387 tons in 1875, and 449,056 tons in 1887.

ONE of the most peculiar freaks of lightning on record is described by Prof. JOHN B. DE MOTTE of De Pauw University, in a recent issue of the *Scientific American*.

The drug store and post office at De Funiak, Florida, was protected by a common sized twisted copper band lightning rod with iron core, fastened to the house by glass insulators. Two tall pine trees stood a few feet back of the building. Aug. 18 1887, during a shower, a number of persons assembled on the porch of the building, seeking the protection from lightning which the rod in use was supposed to give. The lightning struck and shattered the pines in the rear, leaped to the rod and melted its points, ran along the ridge of the roof and down one corner of the building, tearing off the siding and shattering the frame. Mr. JOHN CHISHOLM was thrown forward on his face and taken up for dead. His pantaloons, which were nearly new, were left in a condition somewhat resembling a fish net that has been roughly used, while his brand new shoes looked as if the rats had been feasting on them, the front of one and back of the other being torn completely away. His shirt was torn entirely in two. The sensation he experienced was like a hot blast of air in the back. His body was badly blistered, especially below the knees. After he became conscious, he suffered from heartache and suffocation and a stinging sensation, but after nine months recovered the use of his limbs, and is now only troubled by an involuntary jerk in the back occasionally.

IT is estimated that grade crossings cause fast trains to lose three hours' time in going from Chicago to the Missouri river; and that is a lot of time to lose in getting away from Chicago.—*Philadelphia Inquirer.*

The Manufacture of Dynamo Machines and Electric Lighting Apparatus.

Electric engineering has become almost in a night an important and rapidly developing business, of which comparatively few details are known to those engaged in other branches of engineering work, or even to many of those directly engaged in it. We have therefore concluded that it will be of general interest to give as clear an idea as may be by a detailed description of the processes employed in the electrical manufactures, selecting for the purpose of description the great Thomson-Houston Electric Co.'s works, situated at Lynn, Mass. This company, which four years ago employed but about 250 men, has become at the present time probably the largest manufacturer of electric machinery and apparatus in the world, and now employs over 1,000 men, besides in certain departments, about 200 girls and women.

The present works were established in the fall of 1883 and the main buildings, called for convenience factories *A*, *B* and *C*, are substantial brick structures of three and four stories. The aggregate floor area of the plant is 128,865 sq. ft., or nearly 3 acres. The various shops of the works are lighted by 275 arc lights and 1,200 incandescent lights. There is also a system of overhead automatic sprinklers in use. The plan, Fig 1, and elevation of factory *C* and engine house, (Fig. 2, which will appear next week), show the general arrangement and dimensions of rooms in the various departments, which we proceed to describe.

Arc-Light Dynamo Departments.—The heaviest portions of a dynamo machine are the foundation castings, which are made in pairs and surround the rotating cores or armatures. They are called 'fields", because when wound with wire upon the outside they constitute the field magnets of the dynamo. These pieces vary in weight from 500 lbs. per pair to about 3 tons.

The patterns for the fields are made in a two-story building used as a carpenter shop, situated in the rear of factories *A* and *B*. The power for this shop, formerly supplied by a 20 H. P. engine, is now entirely supplied by a 15 H. P. Thomson electric motor, carrying 110 volts, which converts 92 per cent. of the energy brought to it by wire into work. On the second floor the bases or wooden frames for dynamos are made, also switchboards and boxes and cases for packing. The field castings are brought as they come from the foundry to the heavy machine shop, which occupies the ground floor of factory *A*. About 40 sets of these castings are delivered per week, weighing say 80 tons. This shop is crowded with machines for boring and finishing the fields. The interior surfaces of these, being cup-shaped or spherical, to conform to the spherically wound armature which revolves within them almost in contact, are finished by an ingenious machine, constructed at the works, called a spherical boring bar. The bar carrying the turning tool slowly revolves between the two halves of the fields which are placed in position and would turn a circle within the fields if there was no other motion. The cutting tool, however, is carried on a radius bar which is centered at the center of the spherical shape to be turned, which radius bar slowly swings by means of a worm gear so that the tool is fed to every portion of the spherical surface. A second tool, taking the finishing cut, is similarly mounted on the opposite side of the boring bar.

The bearings are turned and babbitted and the feet planed by a multiple planer taking twelve or more at an operation. The fields are then bolted together by heavy wrought-iron bars. The armature cores, which are shells of cast-iron upon which the wire is afterwards wound, are forced on the shafts by hydraulic power, keyed and pinned. Cross pieces, or bridging pieces, of cast-iron are then put in for the wire to rest on. The copper brushes by which the current is gathered and taken off from the commutators to the armatures are finished on milling machines and also the very neat and simple blowing apparatus or air blast, described later.

This shop, like so many others now-a-days, is furnished with overhead tramways for the convenient handling and moving about of the heavier castings. The armatures are wound on the third floor of factory *A*, which is fitted with special winding machinery. One hundred men are here employed.

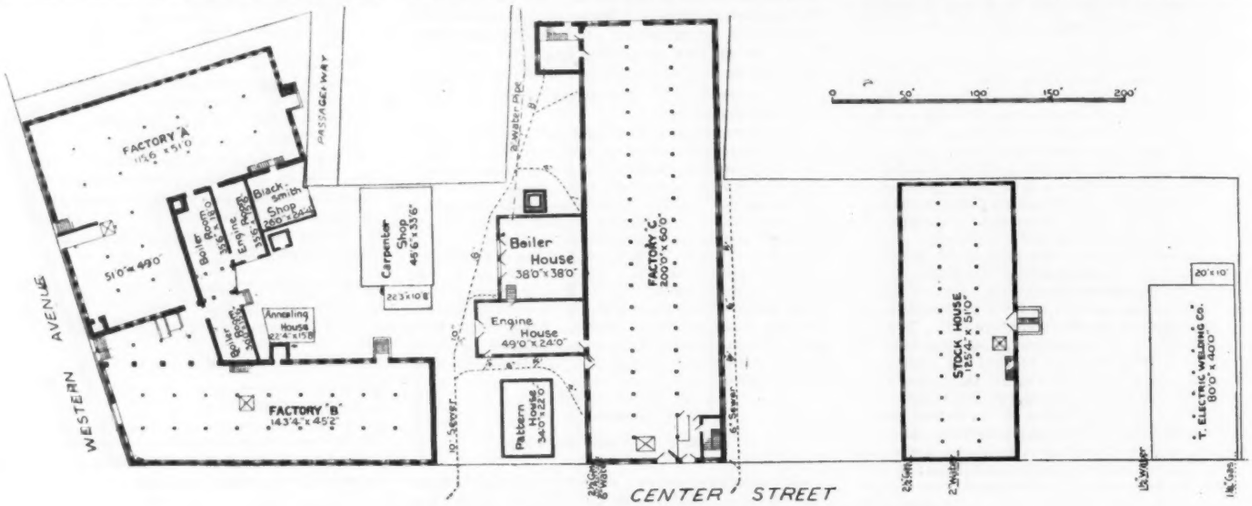

Fig. 1. Plan of the Thomson-Houston Electric Company's Factory at Lynn, Mass.

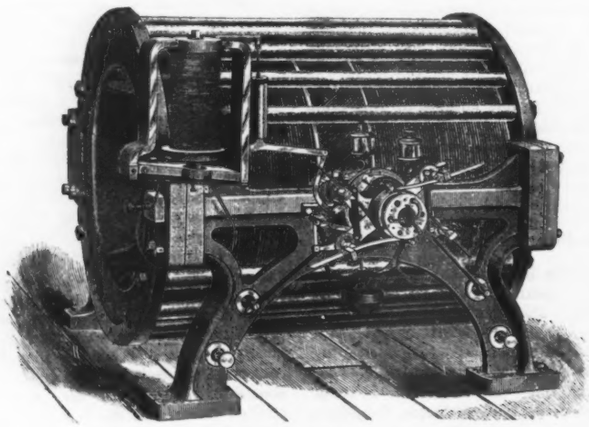

Fig. 3. Thomson-Houston Arc Light Dynamo.

In winding, the core is first covered, in a plane at right angles to the shaft, with soft iron wire, until it assumes a nearly spherical shape. It is then covered with several thicknesses of shellacced canvas, then with the copper wire in which the electric current is induced by the revolutions of the armature in the magnetic field. The coil is wound in three sections, in such manner that the average distance of the wire from the center of the armature is the same in each section. It is wound in the following order: (1) first half of first section; (2) half of second and the whole of the third section; (3) turning the armature back 120° the second half of the second section, and (4) again turning back 120° the second half of the first section. One end of each section is connected with each other, and the other ends are brought out through the center of the armature shaft, which is made hollow for the purpose on the commutator side, and connect with three segments of the commutator, insulated from each other. The covering of the wire cables is of red, white and blue colors to distinguish the different coils. In the winding care must be taken that wires in the same coil do not cross each other. Distance blocks are put in to form open spaces in the armature for ventilation; for, since no electricity can be produced without causing a certain amount of heat (the wastage of energy,) this heat must be carried off, and the air spaces are so arranged that the air currents enter the armature at the sides next the shaft, and the outlets take place through the core. Binding wires, provided with brass tips placed under them at intervals, are used, and the clips are afterwards turned over and soldered to the wires, making the armature wiring solid and immovable. After winding, the armature is tested for balancing, a very important point, by a piece of apparatus which consists of two horizontal straight edges, upon which the armature shaft is supported, and slowly revolved. The armature winding is also tested by sets of gauges representing the distance of the field from the armature shaft, and which are applied to insure that any projecting parts, as of the ventilating tubes, may be filed off. The regulators and magnets for the arc lamps are also wound here.

Each man winding is provided with a Wheatstone's bridge, and tests the resistance of wire placed on the core as he proceeds. Armature winding is done by experts, and has become a skilled occupation in itself.

Adjoining the machine shop, on the ground floor, in the connection to factory *B*, is the arc-dynamo testing room, where a 90 H. P. Corliss engine is well arranged with floor countershaft to run every dynamo when completed, for a certain number of hours, during which it is tested for current and heating. The time of testing varies from 20 to 30 hours. The temperature of the machine is taken before and after the run, and if any undue rise occurs, it is sent back to the department where it was made. Fig. 3 shows the arc light dynamo machine. The brushes by which the current is taken off the commutator are four in number, two leading and two following brushes, and are held in movable yokes, the position of which is determined by the Thomson-Houston regulator on the dynamo machine, shown at the upper left side of Fig. 3. The

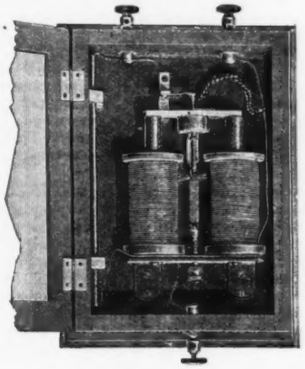

Fig. 4. Controller Magnet.

brushes are made of strips of copper and split in six parts to obtain more spring and better contact with the commutator. An air dash-pot is connected with the brush levers and regulator. The regulator consists of a magnet having its armature suspended beneath it, connected with the brush levers or yokes, the magnetic force of which is governed in its turn by a delicate magnet called a controller magnet, shown in Fig. 4. This magnet is fixed to the wall of dynamo room or other convenient place and is placed in the main circuit of the dynamo. The armature supported by the magnet carries a make and break attachment by means of which the regulator on the dynamo is thrown in and out of circuit as the

Fig. 5. Air Blast.

potential increases or decreases, and causes it to lift or lower the differential yokes carrying the two pairs of brushes, according to the rise or fall of the current. By raising the connecting levers and brushes the potential of the machine is decreased by giving a backward movement to the leading brushes and a forward movement to following brushes. To decrease the potential, the primary brushes are given a backward movement and the secondary a forward movement, and *vice versa*. The brushes are thereby always moved to the portion of constant current, no matter what variations of load occur on the machine and the power and coal consumed is made proportional to the work done.

The air blast, invented by Prof. THOMSON, Fig. 5, consists of three pieces of hard rubber loosely fitted in three grooves making angles of 120° with each other in a hollow circular box attached to the armature shaft. The loose pieces are thrown out by centrifugal force as the shaft revolves, and are forced back again by the elliptic shape of the box or flattening of one side of the circle. The air jet is delivered about ¼ in. in front of the brushes, on opposite sides, and is used to blow out the sparks which would otherwise exist, making it practicable to use oil on the brushes and commutator, reducing wear to a minimum. On this account the brushes will run about three months without requiring to be retrimmed. The commutators are polished by the brushes and are touched for lubrication with a cloth covered with vaseline.

Connecting the dynamo assembling and testing departments and factory *B* is a track provided with trucks for transferring the machines to any part of machine shop, factory *B*, or to a freight elevator to the packing department on the floor above.

On the lower floor of factory *B*, baking ovens are employed, where all armatures which are taken "green", or fresh wound and shellacced, are brought, and by means of an electric current put through them and steam heat combined, every particle of moisture is dried out, and danger from internal short-circuiting by reason of dampness avoided. About fifty armatures are in this department at a time. The current, which is put through first, is tested by instruments until the insulation resistance comes up to 1,000,000 ohms, the time varying. Overhead tracks are used for handling the armatures.

One section of the lower floor is occupied by the dynamos of the shop lighting plant, to the number of 20, which also furnish the current used in the manufacture of incandescent lamps. The belts are shifted by Wellington belt holders, or by a series of wooden rollers in frames, no loose pulleys being used. The dynamos are belted in pairs and the belts are run over each other on the same countershaft pulley. A large switchboard of metal clips, specially designed by Prof. THOMSON for use in factories and mills, permits any number of circuits to be operated from this point, lights being changed from one machine to another without producing flicker in the light. It also permits any number of circuits to be run by one dynamo, up the limit of capacity of the machine. The wires are run overhead through wooden straps, away from the ceiling and pipes, and are protected by hard rubber to avoid danger of accidents to workmen.

(TO BE CONTINUED.)

Papers Read at the Annual Covention of the American Society of Civil Engineers.

MAINTENANCE EXPENSES OF TRACK ON STEEL TIES.

By Mr. J. W. POST, Permanent Way Engineer of the Netherland State Railway.

Metal ties have been used on this railway since 1865, in which year 10,000 Cosyns ties were laid; in 1880 these ties had given satisfactory results as to the metal part during their 15 years of service, but the oak blocks had to be frequently renewed. [These ties consisted of I-beams placed horizontally in the ballast, and having a pair of wooden blocks to which the rails were fastened. It is now considered to be a poor system.]

The following reasons induced the company to look out for a good metal tie: 1, The increasing prices of timber owing to the devastation of forests; 2, The difficulty of obtaining wood ties of satisfactory quality, many that appeared to be good on inspection having to be renewed within a year; the time of felling seems to be of great importance, and cannot be known at the time of purchase, even by severe inspection; 3, The best methods of impregnating proved unreliable, owing to the different degree of saturation of ties treated at the same time; some lasted one and others 20 years, whereas uniformity in this respect is desirable for maintaining the track; 4, Steel ties are guaranteed for two years; 5, There is no loss of interest while the ties are piled to dry, as is the case with wood ties; the metal ties being laid at once; 6, Numbers of wood ties are lost by being burst by rain and frost and by spiking; 7, Wood ties being heavier cost more for transportation; 8, The difficulty and cost of maintenance and renewal of wood ties increase with the number of trains; 9, The value of old metal ties is considerably greater than that of wood; 10, The annual sums for purchase, laying, maintaining and renewing the two types of track show an advantage in favor of the metal ties.

In 1880 Mr. POST was instructed by the company to investigate the different systems in use in various countries, and to make trials of them on the company's lines, and from 1881 to 1888 about 150,000 ties of 10 different types have been experimented with, and careful note made of the maintenance and renewals and expenses for the same. Different systems of fastenings have also been tried. A series of tests was made as to the advantage of annealing the ties after punching the holes, but it is not necessary with mild steel.

The latter types of ties are of the "variable section" designed by Mr POST, the thickness being increased at the rail seat, and the inclination of 1 in 20 also given in the operation of rolling, thus strengthening the tie at the vulnerable spot without incurring extra expense. The ends are closed by turning down. These ties weigh 100 to 120 lbs. each, as compared with 125 to 139 lbs. for ties of uniform section. About 457,300 "Post" ties are now in service in Holland, Belgium, France, Germany, Switzerland and Asia, and about 272,000 more are ordered.

The author uses Verona lock nuts with the rail fastenings, and the nuts and clips are roughened to give the lock-nut a firm grip. The collar of the bolt is eccentric, in order to allow of widening the gauge at curves, and fits tightly into the hole in the tie.

Some of the trials were on a division having curves of 1,100 ft. radius and .016 gradient; oak ties had to be respiked every year, causing great cost for maintenance, and the rail flanges cut the spikes .12 to .16 ins., thus widening the gauge ¼ to ⅜ in. Steel ties, after 1,553 days of service showed a widening of only .08 in., the bolts being worn .04 in.; the holes in the tie were not injured. In no year did the expense amount to 70 cts. per day, per mile, and the average per day-mile was only 50 cts. On marshy ground the amount per day-mile was 29 cts. and 32 cts.

For comparison a trial was also made with track on oak ties, and 10 ties had to be renewed since 1881, but this number would go on increasing. But on the other 24 trials no renewals were made, not one tie being broken, and no renewals are likely to be required for many years.

The expenses on trials dating from 1883 and 1884 was only 28 cts., and some below 20 cts.; and while the time of observation for the latest types of tie has been too short to arrive at any definite expense, everything tends to show that these types will give still better results.

A section of the line near Liége, with curves of 1700 ft and grade of .016, and a traffic of 25 trains per day, was left, after being well ballasted, for 40 months without any work except occasionally evening up the nuts. With wooden ties this would have been very dangerous.

The gauge is well maintained with steel ties, and the lateral displacement of the track is very small, even on sharp curves, if the ends of the ties are closed. The trials with wood ties required up to 1888 two new bearing plates, and 1,081 spikes, but the renewal of fastenings with metal ties was insignificant. Iron is not recommended for ties, mild steel being superior in every way. Broken joints are recommended, especially for sharp curves; the joints should also be suspended.

With proper ballasting the slope of the tie tends to keep the ballast well packed under the rail seat. The trackmen have learned to appreciate the steel ties and make excellent track.

Mr. CHAS. RENSON, of the Liége section, reported that a gang of 4 men working 300 days a year on the track could maintain 5 miles in good condition.

The "Post" steel tie has received much commendation, and many awards at national expositions, and it is being very extensively adopted.

THE Union Elevated Ry. Co., Brooklyn, N. Y., has completed its Broadway line down to the ferry. The stations are under construction and the road is expected to be in operation by July 4. The company is now at work on the Adams St. line to the Brooklyn Bridge.

Steam Heating from the Locomotive.

The Committee on Car-Heating at the last Convention of the Master Car Builders' Association reported the results of 33 practical tests of 18 different systems of heating, all of them using steam from the locomotive. The reports did not cover any scientific tests of the amount of steam used, and for the most part covered only short tests. The main results may be thus summarized.

Twelve systems use steam, with direct radiation, 4 of them using also indirect radiation; 3 systems use steam to heat water in connection with the Baker heater; 2 use direct radiation from water, which means much the same thing. Five systems have the main pipes inside the car, all the others under the floor.

One system (Wisconsin Central) disposes of the water of condensation by a condenser under the car, 2 (the Pennsylvania R. R. and Automatic Car Coupler & Heating Co.) by returning it to the locomotive, and all the rest by traps.

The temperature is controlled by a regulating valve which requires constant attention in 2, more or less attention in 6, very little attention in 8, automatic in 1 (C.M.&St.P.) "one adjustment per trip" in 1. Not much reliance can be placed on these reports; for instance, two systems which have been tested on different roads are reported by one to need "constant" attention, and by another to need "very little". The fact as to all of them, probably, is that they need about as frequent attention as ordinary heaters, while automatic thermostyle regulating valves can be attached to any of them if desired.

None of the heaters employ any other resort for occasional heating without the locomotive except the Gold, which has a drum filled with brine. As a rule the pressure is low, not exceeding 10 lbs. It appears to take from 30 to 60 minutes to heat a car to 70° when outside temperature is 20°, but the reports on this head are very unreliable. The ordinary brass and iron expansion steam trap is the one almost universally used; only one uses a float trap (N. W. Car Htg. & Ltg. Co.).

Steam must be wasted through the rear coupling, according to the reports, in 7, need not be in 8, responses are divided in 2, (as there probably would have been for others, had there been more tests of them), and there is no response for 1.

The flexible connection between cars is rubber hose in 13, 2 of which use corrugated rubber, metallic couplers are used in 5. The metallic connections seem to be a rather weak point.

The pith of the whole elaborate abstract and report, apart from the easily ascertained mechanical details of each, some of the statements as to which should be received with reserve, is contained in the following condensed abstract of "general results:"

NAME OF SYSTEM.	COMPANY REPORTING.	GENERAL RESULTS.
1. Automatic Car-Coupler Heat'g Co.	Det. Lg.& N.	Was a success and gave good satisfaction.
2. Baker Heater Steam-heat'ng Co	Pullm. P. C. Co. Penn. lines	Very satisfactory, requiring very little attention. Heats 6 to 7 cars.
	Pullm. P. C. Co. Penn Co.	Unsatisfactory, when temperature is 20° above zero it has been found necessary to have fires in stoves. Heats 6 cars.
3. Boston & Providen'e	Boston & Prov.	Not entirely satisfactory; many changes yet to be made.
4. Burlington, Cedar Rapids & Northern.	Burl., Cedar R. & N.	General results very favorable; will apply steam pipes to all of our passenger equipment as fast as we can get them through the shop. Heats 4 cars.
5. Chicago, Milwaukee & St. Paul (Gibbs' system)	C., M. & St. P.	As far as heating goes, a perfect success; for comfort and healthfulness, the combination of indirect radiation and ventilation has been a great addition.
6. Erie Car-heating Co.	Lake Shore & M. S.	Think the pipe coil is better than a ball and socket joint.
7. Gold Car heating Co.	Boston & Prov.	Not entirely satisfactory. Many changes yet to be made.
	Penn. R R. Co Pullm. cars	Very good and satisfactory. Heats 6 cars.
	Penn. Co. Pullm. cars	Unsatisfactory on account of requiring educated mechanical help. Heats 7 long cars.
8. Graydon Safety Car Heat'g Co.	Terre Haute & Ind.	Does very well for not more than 5 cars but as many important laws in relation to steam heating are ignored the results are not satisfact'ry.
9. McElroy Car heating Co.	Del. & Hudson Canal Co.	Satisfactory.
10. Martin Anti-Fire Car Heat'r	Boston & Albany	Generally good, but not yet satisfactory. Heats about 12 cars.
	Grand R. & Ind.	Satisfactory.
	Grand Tr'k.	Reasonable satisfaction, but it is thought the pressure of steam in the radiating pipes, which appears necessary, is too high in case of accident.
	Lake Shore & M. S.	Ball and socket joint not as good as pipe coil.
	N.Y., L. Erie & W.	Everything satisfactory except couplings, which cause trouble from leakage and need frequent repairs and renewals.
	Richmond & Danville	Very satisfactory. Heats 10 cars.
11. Northwestern Car Heating & Lighting Co.	No. Pacific	Think system fully equal to, and as nearly perfect, as any in use on any of the roads in the northwestern country.
12. N. York, Lake Erie & Western	N.Y., L. Erie & W.	Results satisfactory as far as tried.
	Chic. & G.T.	Good in moderate weather, but trouble about freezing in pockets of globe valves in severe weather. Not under trial sufficiently long to judge of its merits thoroughly.
13. N'w York Safety Car Heating & Lighting Co.	Lake Shore & M. S.	Failure.
	Mich. Cent.	Failure.
	Penn. R. R. Pullm. cars	Fair and very good. Heats 6 cars.
	Penn. Co. Pullm. cars	Unsatisfactory on account of requiring educated mechanical assistance. Heats 7 long cars.
14. N'w York Safety Car Heating & Lighting Co., combined with Widams' system of railroad car heat'g	N.Y., L. Erie & W.	Trial not advanc'd enough to furnish conclusions.
15. Pennsylvania	Penn. R. R.	More or less objectionable from escape of steam at traps and products of condensation dropping at stations, etc. Heats 10 cars easily.
16. Pennsylvania (Williams' principle).	Penn. R. R.	Comparatively satisfact'y.
	Boston & Prov.	Not entirely satisfactory; many changes yet to be made.
	Grand R. & Ind.	Satisfactory.
17. Sewall Safety Car Heat'g Co	Grand Tr'k.	Reasonable satisfaction, but it is thought the pressure of steam in the radiating pipes, which appears necessary, is too high in case of accident.
	Lehigh Val.	Still in the experimental stage with it. Heats 9 cars.
	Mich. Cent.	Good.
18. Wis. Cent	Wis. Centr'l	In constant service for one month with very satisfactory results.

The Pittsburg Electric Road.

The Observatory Hill Passenger Railway is now in active and continuous operation, and it is reported about to be accepted by the company as entirely satisfactory.

The Wall Street Ferry Electric Road has recently sent out its consulting and supervising engineer on electrical work and terminal facilities, Mr. H. CONSTABLE, to examine some of the peculiarities of this Pittsburg road. Descriptions of the general features of the road and equipment have been published before, and quite generally distributed by the contractors for the electrical outfit, (the Bentley-Knight Co.), but a brief summary of these points from Mr. CONSTABLE'S report is given, as it contains additional details, and as representing the observations of a man familiar with railway as well as electrical work, and entirely independent of any particular electric system, as we believe he is.

"The road is about 3½ miles long. The first four blocks are double-tracked with grades of 3 per cent.; the next five blocks are single-tracked with grades up to 9 per cent., all laid with Johnson rails, dispensing with longitudinal stringers, and cable slot underground conduit. The rest of the road is single-tracked with overhead conductors, and is a succession of heavy curves and grades. There are some 25 curves of 40 ft. radius and upwards and some 36 varying grades with scarcely any level track. Recently they have discovered that one of the grades is 12½ per cent., this was fortunately provided for by the good luck of having plenty of power.

"Altogether the roadway presents a most severe test and the great ease with which the cars take such grades is a most convincing proof of the capacity of electricity for this service, and sets at rest the grade question and many disputed points. The road is built and equipped on the Bentley-Knight system, and a very great deal of credit is due to those having the matter in charge for attempting such a piece of road, and for their perseverance in working it out successfully. Horse traction would be impossible on this line and cable impracticable, owing to the numerous curves.

"The power station is located about a quarter of the way out on the road, and is equipped with 1 engine, 4 dynamos and 2 boilers. The dynamos are coupled tandem, each rated at 250 volts, and would thus give on the line 500 volts. The observations made showed a voltage varying from 465 to 485. The current at the car was not enough to kill a visiting electrician who laid his hand confidently upon the resistance box, although it seemed to scare him a little.) Possibly he was of that numerous class which Mr. SPRAGUE recently referred to, as so far up in the clouds that no ground contact was made).

"Natural gas is used under the boilers, and being such a wonderfully efficient and cheap fuel the actual cost of operation is not a criterion for other places without a very carefully made analysis.

"The cars are equipped with motors on each axle and the brushes are peculiarly free from sparking. The cars are also lighted by electricity.

"During the afternoon and Sunday traffic, the cars ascend these heavy grades with loads varying from 50 to 75 passengers at a speed of 3½ to over 4 miles per hour. A rack and pinion is used on the heaviest grades, but for the summer the racks have been removed except on the heavy grades on the underground conduit division.

"The clogging up of the conduit has not proved to be a serious matter, and the troublesome switching of the overhead trollies has been done away with.

"There has been the usual long delay and experimenting to bring the work to perfection, but now the directors say they have decided to increase the rolling stock and extend the road over the bridge into Pittsburg. The long delays and expensive experimenting attendant upon adopting electricity on roads, greatly retard the cause of electric traction; but until the electric companies and railway men treat the whole question and the peculiar features of each road is a very different manner, there is little to hope of avoiding this difficulty."

These latter remarks of Mr. CONSTABLE'S have a wide bearing. It is quite probable that in this street railway work, most of the electric companies do not realize how different it is from an electric light plant, and with electricians, pure pue simple, owing to their very training, and to their dealing in delicate and intricate mechanisms, it is difficult for them to grasp practically all the varying conditions and details of railway work. Again, street railway men may often fail to see that with all the promises of simplicity, convenience and economy for electric traction it is a vastly different outfit from that needed for a horse railway, and to adopt and adapt it successfully to a particular case requires the judgment and knowledge of an engineer in their interest familiar with the subject.

Explosives and their Composition.*

BY WOLCOTT C. FOSTER.

The following list of explosives, which is arranged alphabetically, contains those mainly which have been either suggested or employed as blasting agents, with descriptions of their composition and references to publications in which notes may be found.

Abel's Powder (Brugière's Powder, Picric Powder consists of 54 per cent. of ammonium picrate and 46 per cent. of potassium nitrate. These two salts may however be mixed in different proportions than those given. *Le Génie Civil*, Oct. 22, 1887; *Eng. & Build. Rec.*, Nov. 26, 1887.

Ætna Powder or Dynamite. The composition of the dope is unknown, but the various grades contain the following percentages of nitro-glycerine:

No. 1	60 per cent.	No. 2 C	33 per cent.
No. 2 XX	50 " "	No. 3X	30 " "
No. 2 X	45 " "	No. 3	27 " "
No. 2	40 " "	No. 4X	25 " "
No. 2 B	35 " "	No. 4	20 " "

Amark's Explosive consists of nitro-glycerine and nitro-mannite or nitro-starch with infusorial earth† and a small quantity of flour or resin. *Chem. Tech. Ztg.*, 1887.

Amide Powder consists of a mixture of potassium nitrate,‡ ammonium nitrate, and charcoal. It is claimed that this powder leaves no residue when exploded. *Eng. Pat.* 14,412, Nov. 24, 1885; *Jour. Soc. Chem. Indust.* 5, 678; *Ibid.* 7, 401.

Amidogène consists of:

Potassium nitrate	73 parts.
Magnesium sulphate	1 "
Charcoal	8 "
Bran	8 "
Sulphur	10 "

It is said to be midway between ordinary gunpowder and dynamite in its effects when exploded. It ignites at a temperature of 180° C. but does not exert an explosive force unless confined. *Eng. Pat.* 2,407; *Ger. Pat.* 23,855, Dec. 10, 1882; *Jour. Soc. Chem. Indust.* 3, 190, 296; *Dingl. Polyt. Jour.* 255, 525; *Eng. Min. Jour.*, Sept. 9, 1882.

Ammoniakrut is said to be similar to Designolle's powder, with the exception of ammonium picrate being substituted for potassium picrate.

Ammonia Powder, also called Ammonia Nitrate Powder, and Nitrate of Ammonia Powder. A number of formulæ for this powder have been published, a few being as follows:

Ammonium nitrate	80 parts.
Potassium chlorate	5 "
Nitro-glucose	10 "
Coal-tar	5 "

Proc. Nav. Inst., 13, 245.

Ammonium nitrate	80 "
Wood charcoal	6 "
Nitro-glycerine	16 to 20 "

Watt's Dict. Chem.

Ammonium nitrate	12 "
Charcoal	2 "
Nitro-glycerine	4 "

Chem. Tech. Zeitung.

The specific gravity of this explosive is 1.5. It is used in many mines but has the disadvantage of being very hygroscopic. *Engineer*, June 4, 1886.

Arlberg Dynamite No. 1, consists of a mixture of:

Nitro-glycerine	65 parts
Barium nitrate	10 "
Infusorial earth	20 "
Charcoal	5 "

Dingl. Polyt. Jour., 255, 525.

Asbestos Powder is nitro-glycerine absorbed by asbestos. Drinker's *Tunneling*, p. 97; Drinker's *Explos. Comps.*, p. 101; *U. S. Pat.*, 120, 756, Nov. 7, 1871.

Asphaline. There are two grades of this explosive. No. 1 is a mixture of potassium chlorate and bran, with or without the admixture of one or more of the following ingredients: potassium nitrate, potassium sulphate paraffin oil, paraffin, ozokerite, soap or fat-since; such mixture to contain not more than 54 parts by weight of potassium chlorate, and 4 parts by weight of potassium nitrate and potassium sulphate, or either of the s., to every 42 parts by weight of bran.

No. 2 is similar to No. 1 with the total amount of potassium nitrate equal to not more than 25 parts by weight in 100 parts of the finished explosive. *Proc. Nav. Inst.* 11, 85; ENGINEERING NEWS, 18, 5.

Atlas Powder (Repauno Chemical Co., Phila.)

	A	*B+*	*B*
Sodium nitrate	2 p. c.	26 p. c.	34 p. c.
Wood fiber	21 "	12 "	14 "
Magnesium carbonate	2 "	14 "	2 "
Nitro-glycerine	75 "	60 "	50 "

No. C+	45 per cent. nitro-glycerine.
No. C	40 " " " "
No. D+	35 " " " "
No. D	30 " " " "
No. E+	25 " " " "
No. E	20 " " " "
No. F+	15 " " " "

Proc. Nat. Inst., 11, 280; *Eng. & Build. Rec.*, Nov. 26, 1887; *Jour. Soc. Chem. Indust.*, 5, 502.

Atlas Dynamite of Engel in Kalk, (European) consists of:

Pyroxyline	18 to 20 per cent.
Nitro-glycerine	55 to 44 " "
Pyro-paper	5 to 10 " "
Nitro-starch	20 to 16 " "
Nitro-mannite	1 " "
Water glass	1 " "

Chem. Tech. Zeitung, 1887.

Azotine consists of:

Sodium nitrate	69.01 per cent.
Carbon	15.23 " "
Sulphur	11.43 " "
Petroleum	4.29 " "

Dingl. Polyt. Jour., 255, 525.

Ballistite consists of nitro-glycerine, sulphur, potassium-nitrate, bran and brick dust.

Bellite, according to the English Patent Specifications, 13,690, Nov. 10, 1885, consists of:

Dinitro benzene	1 part
Potassium-nitrate	0.96 "
or	
Trinitro napthalene	1 part
Potassium nitrate	1.41 "

The mixture is heated to from 50° to 100° C. in order to fuse the nitro-compound and thus cover the nitrate and protect it from atmospheric influences. *Jour. Soc. Chem. Indust.*, 5, 457.

As actually made, however, it is said to consist of ammonium nitrate and dinitro-benzole melted together with a small proportion of potassium nitrate added to the mixture while melted.

It has a specific gravity of 1.2 to 1.4. *Proc. Nat. Inst.*, 13, 247 and 248; ENGINEERING NEWS, 17, 280; *Ibid.* 18, 82; *Chem. News*, Oct. 7, 1887.

Benzine Ammonia Powder consists of nitro glycerine, nitro-cellulose, ammonium nitrate and nitro-benzine together with a picrate. It has a grayish yellow color. *Chem. Tech. Ztg.*, 1887.

Bickford & Spooner's Powder consists of a mixture of nitrated hemp, sulphur and sodium nitrate.

Blake's Safety Explosive consists of one part of sulphur and two parts of potassium chlorate. These two ingredients are kept separate and only mixed when required for use.

Blasting Gelatine (also called Gelatine Dynamite, Gum Dynamite, Jelly Powder, Explosive Gelatine and Gelatinized Nitro glycerine) was discovered by NOBEL and is a compound of nitro glycerine and nitro cellulose. By varying the proportions of the two ingredients the resulting product can be made to vary from a gum of horny appearance to a syrup. The gum state is the one generally preferred and the compound usually has a small percentage of camphor added to it in order to lessen its sensitiveness. It then has about the following composition:

Nitro-glycerine	89 per cent.
Nitro cellulose	7 " "
Camphor	4 " "

Gum dynamite is amber-yellow and transparent, having a specific gravity of 1.6, and does not freeze as easily as dynamite, but is much more dangerous when frozen. It explodes at 143.9° C. when heated on a paraffine bath. The nitro glycerine is not forced out by either pressure or water. This explosive was used very largely on the St. Gothard tunnel work and has been very extensively employed in blasting ever since. Drinker's *Explosives*, pp. 90, 298; Drinker's *Tunneling*, p. 100; *Eng. and Min. Jour.*, June 10, 1882; *Ibid.* April 26, 1879; *Eclectic Eng.*, 24, 160; *Eng. and Build. Rec.*, Nov. 26, 1887; *Jour. Soc. Chem. Industry*, 2, 312; *Ibid.*, 5, 437; *Scin. Amer.*, April 26, 1879.

Blasting Paper, of F. J. Petry, Vienna, is unsized paper coated with a hot mixture of

Potassium ferrocyanide	17 parts.
Charcoal	17 "
Potassium nitrate	35 "
Potassium chlorate	70 "
Wheat starch	10 "
Water	1500 "

The paper is dried and then cut into strips which are rolled into cartridges ready for use. *German Pat.*, 21, 160, July 20, 1882; *Jour. Soc. Chem. Indust.*, 2, 296.

In connection with this see, also, "Dynamogen and Explosive Paper."

Borland's Powder is a powder of the nature of Schultze or E. C. Powder, but containing dinitro-cellulose only. *Jour. Soc. Chem. Indust.*, 7, 401; *12th An. Rep't. Her Majesty's Inspectors of Explosives.*

Borlinetto's Blasting Powder.

Picric acid	10 parts.
Sodium nitrate	10 "
Potassium chromate	8.5 "

Eissler's *Modern Explosives*, p. 136.

Brady's Dynamite consists of

Nitro-glycerine	33 per cent.
Sodium nitrate	50 "
Charcoal	10 "
Sulphur	7 "

Brain's Powder is composed of 40 per cent. of nitro-glycerine, with a mixture of potassium chlorate and nitrate, wood charcoal and pressed sawdust. Drinker's *Tunneling*, p. 85; Drinker's *Explosive Compounds*, p. 87.

Bronolite is a mixture of barium sodium picrate and lead sodium picrate, with potassium nitrate and highly nitrated naphthalene.

Brown Prismatic Powder (Cocoa Powder).—The composition of this powder is unknown, but probably it is a powder in which ordinary wood charcoal is replaced by peat charcoal. *Proc. Nav. Inst.*, 13, 586.

Brugière's Powder.—See Abel's Powder.

Cadmite consists of:

Nitro-glycerine	20 parts.
Potassium nitrate	56 "
Sulphur	10 "
Coal	4 "
Cellulose	4 "

Callou's Blasting Powder is a mixture of potassium chlorate and orpiment (yellow sulphide of arsenic). Wagner's *Chem. Tech.*, p. 184.

Carboazotine, the invention of Cahuc and de Soulages, of Toulouse, consists of:

Potassium nitrate	61.04 per cent.
Ferrous sulphate	00.73 "
Soot and tan or lampblack	24.65 "
Sulphur	13.58 "

It is not granulated, is from 60 to 70 per cent. lighter than gunpowder and tolerably hygroscopic, but may be dried at a stove heat without danger. Being very difficult of inflammation and quiet in action it is exceedingly safe in use, but must be closely tamped, which can, however, be done with an iron bar. *Eng. and Min. Jour.*, Aug. 7, 1880; *Dingl. Polyt. Jour.*, 255, 525. This is the basis of Judson's Powder, which see.

Carbo-Dynamite is nitro-glycerine absorbed by a special, highly absorbent, charcoal. *Jour. Soc. Chem. Ind.* 7, 401; *12th Ann. Rep't. of H. M. Inspec. Explosives*

Carbon Dynamite No. 3, from MAHLER and ESCHENBACHER, of Vienna, is a substance analogous to the weaker kinds of Dynamite made by NOBEL, and contains a certain proportion of nitro-glycerine absorbed by a material which is, essentially, an imperfect gunpowder. *Eng. and Mining Jour.*, Aug. 7, 1880.

Carbonite is an explosive introduced by HELLOF of Berlin, and is said to consist of nitro-benzine, potassium nitrate, sulphur, and kieselguhr. It has a neutral reaction, and is proof against explosions due to sudden blows. It is used quite extensively in coal mining, and can be fired with safety in an atmosphere containing from 7 to 8 per cent. of fire damp, as well as large amounts of coal dust. *Dingl. Polyt. Jour.* 261, 2529; *Jour. Soc. Chem. Indust.* 5, 502; *Eng. and Min. Jour.* Dec. 24, 1887.

Cellulose Dynamite, (Lignine, Nitro-Cellulose Dynamite) contains 75 per cent. nitro glycerine absorbed by 25 per cent. nitro-cellulose. *Jour. Soc. Chem. Indus.*, 3, 533; *Chem. Tech. Ztg.*, 1887; Drinker's *Explos. Comps.*, p. 88.

Coal-Fulgerite is a variety of Fulgerite, which see.

Cocoa Powder.—See Brown Prismatic Powder.

Collodin.—See VOLKMANN's Wood Powder.

Colonia Powder is a mixture of 60 per cent. of gunpowder and 40 per cent. of nitro-glycerine. Drinker's *Tunneling*, p. 86; Drinker's *Explos. Comps.* p. 88.

Coopal's Powder consists of nitro-lignin (nitro cellulose from hemp or cotton waste) with sodium nitrate and starch.

Designolle's Powder, as made for blasting and other purposes where maximum effect is required, consists of 50 per cent. of potassium nitrate and 50 per cent. of potassium picrate.

For use in rifles it is made of potassium nitrate, with a little charcoal, and from 12 to 20 per cent. of potassium picrate.

For cannon it contains from 8 to 12 per cent. of potassium picrate. *Eng. and Building Rec.*, Nov. 26, 1887; *Le Génie Civil*, Oct. 22, 1887; Drinker's *Explos. Comps.*, p. 91.

Diaspon Gelatine contains,

Nitro-glycerine	72 to 75 parts
Nitro-cellulose	5 to 7 "
Alcohol	0.5 to 2.0 "

Diller's White Dynamite consists of nitro-glycerine absorbed by calcium carbonate.

Diorrexine consists of,

Picric acid	1.65 per cent.
Charcoal	7.19 " "
Beech sawdust	10.57 " "
Potassium nitrate	42.18 " "
Sodium nitrate	25.16 " "
Sulphur	13.40 " "
Water	0.55 " "

Dingl. Polyt. Jour., 255, 521; *Jour. Soc. Chem. Indust.*, 3 192.

Double Ammonia Powder of W. WENDIN, consists of,

Nitro-glycerine	60 per cent.
Nitro-cellulose	5 " "
Ammonium Nitrate	25 " "
With some picrate	

The nitro-glycerine in this powder is gelatinized with nitro cellulose made by treating cotton with an acid mixture which has been used for nitrating carbonic acid. By this means the nitro-glycerine can be gelatinized at ordinary temperatures, and hence the danger which is incurred from heating the mixture, when the common method is pursued, is entirely obviated. *Chem. Tech. Ztg.*; *Eng. and Min. Jour.*, Feb. 25, 1888.

Dualin, the invention of CARL DITTMAR, a Prussian officer, consists, according to TRAUZL of,

Nitro-glycerine	50 per cent.
Fine sawdust	30 " "
Potassium nitrate	20 " "

It is more sensitive to heat and also to mechanical disturbances, especially when frozen, (when it may even be exploded by friction,) than dynamite (kieselguhr) No. 1. Exudation of the nitro-glycerine is also liable to occur. The specific gravity of this explosive is about 1 to 2. It is very extensively used. *Ect. Eng.*, 5, 173; *Eng. and Build. Rec.*, Nov. 26, 1887; *Le Génie Civil*, Oct. 22, 1887; Wagner's *Chem. Tech.* p. 160; Drinker's *Tunneling*, p. 85; Drinker's *Explos. Comps.*, p. p. 87, 100; *U. S. Pat.*, 98, 854, Jan. 18, 1870.

Dynamite or Giant Powder "is a mixture of nitro-glycerine with any dry, solid substance, whether mineral or vegetable, so pulverized or comminuted, and mixed in such proportions, that, on the one hand, the mixture contains sufficient nitro-glycerine to form an efficient explosive compound, and, on the other hand, the proportion of absorbent used is sufficiently large to hold the nitro-glycerine against leakage or exudation. These proportions of nitro-glycerine and absorbent must, moreover, be so graduated that the mixture retains the pulverulent form." Drinker's *Explos. Comps.*, p. 70.

(For the compositions of the various dynamites look under the respective names of the several brands or of the makers, such as, Noble's Dynamite, Ætna Powder, Arlberg Dynamite, Atlas Powder, Brady's Dynamite, Carbon Dynamite, Cellulose Dynamite, etc.) Hill's *Explosives*; EISSLER, *Modern Explosives*,; Drinker's *Tunneling* and *Explosives Compounds*; and numerous papers in the technical journals and transactions of engineering and scientific societies.

Dynamite Rouge Red Dynamite, is a mixture of 66 to 68 per cent. of nitro-glycerine with ferric oxide.

Dynamogen.—Paper Blasting Powder. (Similar to blasting paper which see) consists of filter paper covered with the following mixture:

Potassium Ferrocyanide	17 parts
Charcoal	17 "

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†Infusorial earth (also called diatomaceous earth, silicious earth, kieselguhr,) is a substance composed of the silicious skeletons of fossil diatoms. Being composed of these minute tubular shells it is very spongy and compressible, and will absorb a large quantity of nitro-glycerine, holding it very strongly by capillary attraction. NOBEL says that, when pulverized, this earth will absorb about three times its own weight of nitro glycerine. It is found in many places, notably in Hanover, Europe and in New Jersey.

‡In many powders sodium nitrate is substituted for potassium nitrate because of its being cheaper. It can, however, only be used in powders which are to be used very shortly after being made, as it rapidly absorbs water from the atmosphere and thus destroys the power of the explosive.

Mixed with 150 parts of boiling water. When this mixture has become cool the following are added:

Caustic Potash	25	parts
Potassium Chlorate	70	"
Starch	10	"

Triturated in 50 parts of water. The whole is then stirred so as to constitute a thin paste which is applied to the paper. *Proc. Nav. Inst.*, 8, 449; *Ibid.*, 17, 115.

E. C. Powder.—Sporting powder consists of rifle gun-cotton colored with aurine dissolved in a mixture of ether, alcohol, and benzoline. Rifle powder is the same as the above except that picric acid is substituted for aurine. *Proc. Nav. Inst.*, 11,85; *Jour. Soc. Chem. Indust.*, 7,401.

Ehrhardt's Powder is a potassium chlorate powder.

Electric Powder consists of nitro-glycerine absorbed by an explosive dope, the composition of which is a secret. No. 1 contains 33 per cent. of nitro-glycerine and No. 2, 28 per cent. *Le Génie Civil*, Oct. 22, 1887; *Chem. Tech. Ztg.*, 1887.

Emilite is made by subjecting the portion of coal-tar oil boiling between 185° and 259° C., and soluble in alkalies, to the action of nitric acid, thus converting it into an explosive nitro compound. *Eng. Pat.*, 5 899, April 22, 1887; *Jr. Soc. Chem. Indust.*, 6, 521; *Engineering News*, 18, 129; *Eng. and Min. Jour.*, Aug. 6, 1887.

Emmensite consists of two non-explosive substances, which, when mixed together form an explosive compound. What these two materials are has not, as yet, been made public. It is made in several grades and was tested on the Croton Aqueduct and the D. L. & W. R. R. with results said to have been very satisfactory *Age of Steel*, Dec, 3, 1887; *Colliery Manager*, Feb. 17, 1888; *Industries*.

Esper's Explosive.—For blasting purposes it has the following composition:

Sodium nitrate	66	per cent.
Sulphur	12	" "
Sawdust from hard wood	22	" "

For artillery purposes 10 per cent of charcoal is added. For certain purposes the following mixture is preferred:

Sodium nitrate	66	per cent.
Sulphur	8	" "
Sawdust from hard wood	21	" "
Charcoal	5	" "

Eng. Pat., 6,548, 1884; *Jr. Soc. Chem. Indust.* 4, 417; *Eng. and Min. Jour.*, April 16, 1881.

Etnite.—This explosive consists of Asphaline with the addition of a small percentage of sulphide of antimony. It is over-sensitive, especially to combined friction and percussion, such as a glancing blow. *Engineer*, June 4, 1886.

Explosive Gelatine.—(See Blasting Gelatine.)

Explosive Paper.—Several explosive papers have appeared from time to time, and while the pastes used in coating the paper all have essentially the same characteristics, still they differ slightly in one or two of the ingredients employed. The composition of two of these pastes is as follows:

Potassium nitrate	8	parts.
Potassium chlorate	5	"
Charcoal	1	"
Fine sawdust from hard wood	1	"

Mixed with gum water, and plastered on paper, *Proc Nav. Inst.*, 11, 115.

Potassium nitrate	4.5	parts.
Potassium chlorate	9.0	"
Charcoal	3.25	"
Potassium ferrocyanide	3.25	"
Potassium chromate	0.06	"
Starch	0.05	"

Mix with 80 parts of water, and impregnate the paper with the mixture. (In this connection see blasting paper.

Extra Dynamite was invented by NOBEL, and consists of a mixture of gelatinized nitro-glycerine and ammonium nitrate in the following proportions:

Nitro-glycerine	55.6	per cent.
Nitro cellulose (gun cotton)	4.8	" "
Ammonium nitrate	35.5	" "

It is colored by a red coloring matter, and intermediate in its properties between blasting gelatine and dynamite. It is more extensively used in Sweden than any other explosive. *Chem. Tech. Ztg.*, 1887.

Fenhoen's Powder consists of a mixture of gun-powder and nitro-naphthalene.

Forcite, when manufactured according to J. LEWIN'S patent, consists of:

Nitro-glycerine	70	per cent.
Nitro-cellulose	1	" "
Dextrine	5	" "
Potassium nitrate	15	" "
Sawdust, wood pulp or charcoal	9	" "

As made by the American Forcite Company, No. 1 consists of:

Nitro-glycerine	75	per cent.
Gelatinized cotton	7	" "
Potassium nitrate	18	" "

No.	Per cent.			
1, Extra,	80	Nitro-glycerine.	Remainder	Unknown.
2, "	50	"	"	"
3, "	40	"	"	"
3 A, "	35	"	"	"
3 B, "	32	"	"	"
3 C, "	30	"	"	"

X, consists of 95 per cent, nitro-glycerine with 5 per cent. cellulose matter.

Proc Nav. Inst., 11,100; *Engineer*, June 4, 1886; *Chem. Tech. Ztg.*, 1887.

Fortis Explosive is a nitrate mixture containing varying proportions of ferrous sulphate. 12th *Ann. Rep. H. M. Inspec. Explos*; *Jour. Soc. Chem. Indust.*, 7, 401.

Fulgurite when solid consists of 4 parts of corn meal and 6 parts of nitro-glycerine; when liquid, of one part of corn meal and 9 parts of nitro-glycerine. Drinker's *Tunneling*, p. 98; Drinker's *Explosive Comps.*, p. 102; *U. S. Pat.* 153,086, July 14, 1874.

Fulminatin consists of a mixture of 85 per cent. of nitro-glycerine and 15 per cent. of wool.

Fulminating Oil is one of the names given to pure nitro-glycerine.

Fulmin-Mannite (Nitro-Mannite) is nitrated sugar of manna. Its tendency to decompose spontaneously prevents its extensive employment. Drinker's *Tunneling*, p. 61; Drinker's *Explos. Comps.* p. 62.

Fulmin-Sugar (Nitro-Sugar, Nitro Cane Sugar) is nitrated cane sugar or nitrated glucose. It possesses strong explosive properties, but as it is very difficult to obtain a uniform product, it has not found any very extensive employment. It is soluble in ether and alcohol, and is sometimes used for waterproofing ordinary gunpowder. *Chem. Tech. Ztg.*

Gelatine Dynamite:

	No. 1.	No. 2.
Nitro-glycerine	58 Per cent.	38.8 per cent.
Nitro-cellulose (gun cotton)	2 " "	1.2 " "
Potassium nitrate	28 " "	45.0 " "
Cellulose	12 " "	15.0 " "

(See also, in this connection, blasting gelatine which is some times called gelatine dynamite).

Gelatine Forcite:

Nitro-glycerine	95	per cent.
Cellulose (not nitrated)	5	" "

Eng. and Build. Rev., Nov. 26, 1887; *Le Génie Civil*, Oct. 22, 1887.

Gelatinized Nitro-Glycerine. (See Blasting Gelatine).

Gelignite:

Nitro-glycerine	56.5	per cent.
Nitro-cellulose	3.5	" "
Wood bark	8.0	" "
Potassium nitrate	32.0	" "

Giant Powder (Dynamite).

NOBEL'S No. 2.

Nitro-glycerine	20	Parts by weight.
Sodium nitrate	70	" " "
Resin pulverized	10	" " "

To this may be added from 5 to 10 parts of flour of sulphur. Drinker's *Explos. Comps.*, p. 102; *U. S. Pat.*, 141, 455, Aug. 5, 1873.

American Giant Powder No. 2, as made by the Giant Powder Co. and the Atlantic Giant Powder Co., formerly consisted of

Sodium nitrate	40	Parts by weight.
Rosin	6	" " "
Sulphur	6	" " "
Infusorial earth	8	" " "
Nitro-glycerine	40	" " "

U. S. Pat., 130, 468, June. 3, 1873; Drinker's *Explos. Comps.*, p. 102; *Ibid.*, p. 71.

As now made it consists of

Nitro-glycerine	40	per cent.
Sodium nitrate	48	" "
Sawdust	12	" "

The other grades of powder made by these companies contain

No. 1	75	per cent. nitro-glycerine.
No. 1, New	50	" " " "
No. 2, Extra	45	" " " "
No. 2	40	" " " "
No. 2 C	33	" " " "
No. XXP	27	" " " "
No. M	20	" " " "

Drinker's *Tunneling*; Drinker's *Explos. Comps.*, p.p. 73 to 86; Hill's *Explosives*; *Trauzl's Explosive Nitril-bindungen*, etc.

Glonoine is one of the names given to pure nitro-glycerine.

Glyxoline is a preparation of gun cotton pulp and potassium nitrate saturated with nitro-glycerine. Drinker's *Tunneling*, p. 63.

Gruson's Explosive is said to be similar to Pandastile Gum Dynamite. (See Blasting Gelatine).

(TO BE CONTINUED.)

ENGINEERING NEWS.

THE Brooklyn Board of Aldermen have given permission to the Brooklyn City Railroad Company to try the River and Rail Electric Company's new storage battery electric motor on their Third Avenue line. Arrangements have been made at Fort Hamilton for charging the batteries, and a car has been made ready for trial by Prof. MAIN. The trial will probably begin June 10, and continue from three to five weeks. A trial may also be made on some of the other lines on which the grades are heavier. The system is one possessing many novel and interesting features, which we have described in outline already, and shall decribe more fully later. The motor, batteries, mechanical and electrical connections are all new in type and are claimed to give unusual efficiency for the same weight. Certainly the plant is lighter by far than any other street car plant as yet before the public.

Mr. WM. E. MERRILL, Lieut. Col. U. S. Engrs., Cincinnati, O., has published a card asking for statistics and information concerning collisions of boats with bridge piers on the Ohio river. In 1882 a table showing losses incurred by accidents of that date was published, and he now desires to include in the report for the present fiscal year a revised edition of the same table carried forward to June 30, 1888.

THE gas question is sorely perplexing the Mayor of Philadelphia. The only bid received was for either of four kinds of water gas. While it is much cheaper than coal gas, it is admitted to be dangerously deleterious to health, because it contains a larger proportion of carbonic oxide, while sometimes it clogs both the pipes and burners with deposits. The Philadelphia bids fix the percentage of this poisonous oxide at from 24½ to 26 per cent., which is dangerous to health.

ACCORDING to Professor E. DIETRICH, of Berlin, there are only 57 bridges of brick or stone existin having a span greater than 131 ft. Forty of these have spans lying between 131 ft. and 164 ft., 10 have spans of from 164 and 200 ft., 3 of from 200 to 230 and one only, the Cabin John bridge, near Washington, exceeds this limit, and has a span of 237 ft. Thirty of these are road and 22 are railway bridges; one carries a canal, another a conduit, and 3 are not classified. Fourteen of them date from before the commencement of the present century, 22 were built between the years 1800 and 1860, 5 between 1860 and 1870, 6 between 1870 and 1880, and since then 10 have been erected. In 22 of the bridges the rise lies between one-half and one-third of the span, in 18 between one-third and one- fourth the span, in 10 between one-fourth and one-fifth the span, and in 6 between one-fifth and one-eighth the span. one bridge only, a road bridge in Turin, has a flatter arch than given by the smallest of the above ratios, and in this case the rise is .18 the span. The radius at the crown lies in 15 cases between 66 ft. and 98 ft.; in 8, between 98 ft. and 131 ft.; in 11, between 131 ft. and 164 ft. and in 3 cases, between 164 ft. and 187 ft. 8½ ins. the latter being the radius at the crown of the the Devil's Bridge, at Bevizzo, Italy.

THE report of the Denver & Rio Grande Ry., recently issued, gives the following examples of the cost of building a railway in mountainous regions:

	Miles.	Total cost.	Average per mile.
Glenwood extension	64.29	$2,917,067	$45,373
Aspen extension	41.21	1,136,560	27,579
Ouray extension	35.86	597,462	16,698
Total	141.28	$4,651,089	$32,921

The average for the entire 141 miles is a little less than $33,000 per mile. Probably there was no expense whatever for right of way or terminals—items which form a very great addition to the average cost of railways in thickly settled regions.

THE *Popular Science Monthly* describes a curious and ingenious device called "The Echo Maker" to be used on ships at sea. A flaring funnel is screwed to the muzzle of a rifle. When a supposed obstacle is near the vessel the rifle is fired in its direction, and if the obstacle is there the beam of sound projected through the funnel strikes the obstacle and rebounds, and as the echo is more or less perfect in proportion as the obstacle is more or less paralled to the ship from which the gun is fired, and as it is near or remote, the position of the obstacle may be inferred. The inventor claims that a sharp sound projected at or nearly at an object, and only when so directed, will in every case return some of the sound sent, so that, theoretically, there will always be an echo, and the difference in the time between the sound sent and the echo will indicate the remoteness of the object. The naval board tried the echo maker and found that a return sound could be heard from the side of a fort half a mile away; from passing steamers a quarter of a mile off if broadside to; from bluffs and sails of vessels at about the same distance, and from spar buoys 200 yards away.

THE order granting to ROBERT HASTINGS and others the right to lay, maintain and operate in all the thoroughfares of the city and county of San Francisco pneumatic tubes for the transmission of messages and parcels by compressed air and electricity, has been approved by the Street Committee of that city. The tubes must not exceed 2 ft. in diameter. The franchise is for 25 years. The grantees must give bonds to the amount of $25,000 and the work must be commenced within 12 months from the approval of the order.

AN item in the Sundry Civil bill just reported to the House, provides for a preliminary survey, to establish the boundary line between Alaska and British Columbia. The interests of both Great Britain and the United States on and near the line in dispute have greatly increased in value of late years, and the presence of the dispute is already a source of irritation and danger. The President and Secretary BAYARD both called the attention of Congress to the importance of the matter and recommended very strongly that Congress make the necessary appropriation to secure its settlement. This the House Committee on Appropriations refused to do, but they now provide for a survey which will lead to arbitration and the greatly desired settlement.

THE National Pure Drinking Water Automatic Supply Association has been organized in London to supply drinking water at railway stations and other public places, on the principle of the "drop-a-nickel-in-the-slot" machines. A glass of filtered ice-water will be delivered for one cent, an automatic measuring tap being used. The capital stock is $500,000. The company would seem to have a good field for operations, and has good prospects of success if the results of the various automatic machines for weighing, delivering matches, postage stamps, candy, etc., are considered, but it would seem as if so cheap a commodity as ice-water might well be supplied gratis, as it is here on trains and for the most part at stations. As a rule, where it is not supplied here, it is in the interest of the soda-water stands, and not to save the direct cost of the water.

LIEUT. ZALINSKI'S latest is a 15-in. torpedo gun with a range of 2 miles, built for the Italian Government and probably to be mounted at Spezzia. It is 10 ft. long and made of cast-iron, in sections, without interior casing. The thickness is 1⅛ ins. It is mounted on a hollow cast-iron cone, the gun being at the apex and resting in a solid half circle of iron, so that it may be elevated or depressed. The mechanism for pointing the gun up or down or to right or left is worked by hydraulic power.

The shells are to be introduced by the same means when placed on a cradle. They are 6 ft. long and have iron wings. The shells used at a trial held recently at Fort Hamilton were dummies loaded with sand, and weighed 530 lbs. each. The largest shell the gun will take is one of 900 lbs., which will contain 600 lbs. of explosive gelatine, equivalent to 1,000 lbs. of gun-cotton. By very simple means, such as adjustable metal sabots, the diameters of the shell may be varied in the gun according to the charge. One very remarkable characteristic of the arm is that the range may be varied without changing the elevation of the piece, the shell going further when more air pressure is given it, or dropping nearer as the air force is diminished. The hydraulic lifts are very ingeniously arranged, the long gun rising up or lowering at a touch of the lever.

AT the trial, two shots with 530-lb. shells were fired at an elevation of 18° to find out what were the powers of the new arm, the whole air pressure not being called into play. The first shot fell some 1,200 yds.; the second, with a more continued pressure, considerably over a mile. When the full pressure is brought to bear, the shells, with their 600 lbs. of explosives, will be sent two miles.

The gun is so arranged that by a series of levers one man can move it at will and fire it. Three guns of this size to be worked in the same way will form the armament of the Vesuvius, lately launched in Philadelphia. The experiments were thought to be quite conclusive of the ease with which the gun could be managed and its accuracy. Lieut. ZALINSKI has certainly scored a great success. He began with a 2-in. gun, and then tried successively and successfully a 4-in., 8-in. and now 15-in.

THIS is a presidental campaign year in Colombia, Ecuador and Bolivia as well as in the United States, and great disorder and disturbances are predicted in all three of these South American republics. In Ecuador the elections were held some months ago but the votes will be counted this month; according to report the military, police and Government employés alone were allowed to vote. In Colombia too the Government has been trying to influence the voting. A dispatch from Panama, published in the New York *Times*, ends with the following significant remarks: "But there is no betting on South American elections, and nothing is more significant when it is remembered that these people are gamblers by nature, training, association and habit."

A NOVEL pile, to resist the action of the teredo has been suggested to the Harbor Commissioners, San Francisco, Cal., by R. B. MARKHAM. It is made of a 4 x 4 in. center piece with 1-in. planks nailed on to build up the pile to any required size; each layer of planks being coated with tar and covering the joints of the layer below. It is claimed that the teredo will only pass through solid wood, and that successful tests have been made. The inventor has been directed to submit two piles, which will be tested by the Board. The experiment is certainly an interesting one.

THE question of a tunnel between Sealand and Sweden, under the Sound, had not been heard of for some time but lately the Royal Swedish Commissioners, who were examining M. DELANCLE'S application for a concession, sent in their report to the Swedish Government. It is a very elaborate document which ends with the following conclusions:

"That a submarine railway between Sealand and Sconia would no doubt insure several advantages to the international traffic; but that, as the building of it would require a very considerable capital, and the paying of the interest on the cost for a long series of years, would necesitate heavy subventions from both the Danish and the Swedish Governments, in addition to the profits of the traffic, which would be inadequate for this purpose, the proposal for this new way of communication be abandoned for the present; that should ever, under altered circumstances, the want or the desirability of a submarine railway come into prominence, it ought to be built on account of the State, either with its own money or by the aid of capital borrowed for that purpose, and the works should be carried out under superintendence of special commissioners, or be contracted away to some accepted person.

"This arrangement is considered necessary in order to insure to the authorities of these State railways, with which the tunnel would have connection, a proper control of the traffic, independent of foreign companies or interests; and finally, that there only in the last instance, ought to be any question of altogether handing over the undertaking to foreign capital, and that the Governments, under no circumstances, ought to tie themselves by entering into contract with private associations or persons before complete plans were forthcoming, and the question of cost fully solved." The Commissioners submit, in conclusion, that M. DELANCLE'S application be not granted. The Government has not yet taken any further steps in the matter.

THE Arthur Kill bridge, at Staten Island, with a draw of 500 ft., the longest draw-span in the world, is rapidly nearing completion, and it is expected will be ready for traffic by July 4. Four of the massive piers of solid masonry are already finished and the fifth will be done very soon. The piers are of dolomite limestone from Sandy Hill quarry 100 miles north of Saratoga, and are tastefully finished in granite. Work was begun on them last July and was continued unremittingly through all the bad weather of February and March. The construction of this bridge will make available nearly ten miles of hitherto unoccupied shore line, upon which wharves, docks, and transhipping facilities are expected to quickly appear.

THE Reading Railroad has recently made a test to determine the relative cost of different sized coal as fuel, and also the relative economy of different locomotives belonging to the company. Two engines, one fitted with a wagon-top boiler and narrow fire box, and the other with a Wootten boiler and fire box, each hauled 145 loaded cars from Palo Alto to Port Richmond, and 165 light cars from Port Richmond to Palo Alto. The result was that the wagon-top consumed 11¾ tons of steamboat coal, at $2.45 per ton, equal to $29.09, while the Wootten consumed not quite 14½ tons of buckwheat coal at 60 cts. per ton, equal to $8.60.

THE names of some of the contractors who are to construct the Arcade Railway have been made public by the General Manager, MELVILLE C. SMITH. Among them are: The Phœnixville Iron Works, Pennsylvania; BARTLEY & HAYWARD, Architectural Iron Works, Baltimore; P. DICKINSON, N. Y.; HENRY J. DAVIDSON, N. Y.; and RYAN & MCDONALD. Five vacancies which existed on the Board of Directors have been filled by the election of FREDERICK P. OLCOTT, Gen. RICHARD A. ELMER, EDWARD A. ABBOTT; Gen. JAMES JOURDAN, and JAMES E. GRANNISS.

The permanent Board of Directors will be chosen at the annual election to be held in July.

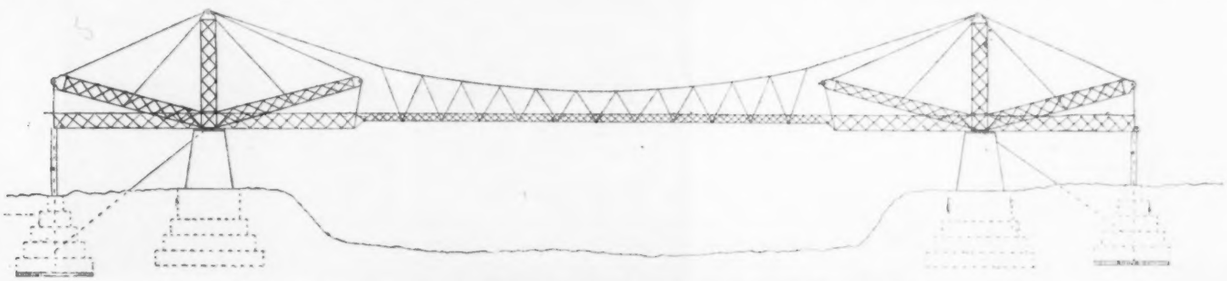
CORRESPONDENCE.

Proposed Design for Very Long Span Bridges.

CORDOBA, Arg. Rep., May 1, 1888.

EDITOR ENGINEERING NEWS:

The publication in ENGINEERING NEWS, of the plans of the projected bridge over the North River has led me to present the inclosed design for long span bridges. It will be seen upon inspection that the design consists of a combination of the cantilever and the suspension systems. Bridge engineers generally do not favor a combination of different systems in the same structure on account of the ambiguity arising in regard to the strains; but this combination is entirely free from this objection, as no ambiguity can exist in regard to the weights supported by each system. In fact the two systems might be made entirely separate with the exception of the connection made by the roadway.



Proposed Design for Bridges of Very Long Span. By W. A. WARREN, C. E.

The limit of the span possible by the combination approaches the sum of the limits of each system alone. For example, the cantilevers of the Firth of Forth bridge could be combined with the cables of the East River bridge without increasing the strains in the cantilevers, and the only increase in the strains on the cables would be that caused by their greater length.

The advantages of the combination over the cantilever system alone, are, that longer spans are possible, and greater economy in shorter spans. Its advantages over the suspension system alone are, that longer spans are possible, and a greater increase in rigidity.

With this brief explanation I submit the design to the consideration of the engineering profession.

Yours truly, W. A. WARREN.

The Theory of Earthquakes.

PHŒNIXVILLE, Pa., June 27, 1888.

EDITOR ENGINEERING NEWS:

I beg to send you herewith the M. S. of a translation of a very remarkable article on the new theory of earthquakes, by its originator DR. RUDOLF FALB.

This article presents a résumé of important facts gathered by Dr. F. during twenty years of diligent research, closing with a statement of his theory, which deserves to be given the widest publicity. Desirous to aid in this connection, I have decided to send the translation to your journal first, knowing that your circulation is very considerable among engineers and scientific men interested in such questions. Perhaps you may think that the subject treated is somewhat foreign to the professional character of "ENGINEERING NEWS;" yet, considering the profound interest felt by the public in general, and the scientific world in particular, in anything definite concerning the character and causes of earthquakes, I thought it should be offered to you. As to my translation, I, of course, guarantee the correctness of the text. Being German by birth as well as by education, I am competent to appreciate the exact sense and meaning of the original. As regards the question of right involved, of translating the article, I can only say that there is no mention made at the head of the article (as published in No. 15 of the German Weekly the *Gartenlaube* of 1888) forbidding its translation, as there is sometimes at the heads of other articles in that magazine. On the contrary, I think, Dr. FALB will be pleased to have his name and work go out into the English speaking world announcing his most interesting discovery. Yours truly,

F. G. LIPPERT.

[We shall begin next week the publication of this most interesting article.—ED. ENG. NEWS.]

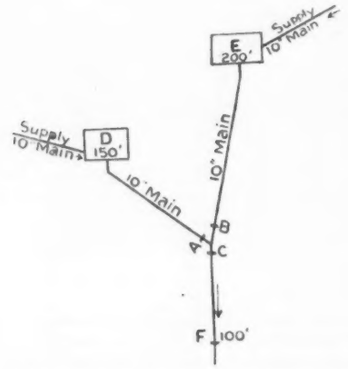
A Hydraulic Conundrum.

NEW YORK, June 21, 1888.

EDITOR ENGINEERING NEWS:

I enclose a little explanation of a question in your issue of June 16, "in case you have no other."

Valve at F closed, water flowing from E into D through pipe E, C, D, under head = difference of



level of D and E. The pressure at F will be that due to the piezometric head at C, that is: it will be the static head due to the elevation of E above F, less the head expended to overcome the resistances in the pipe from E to C.

It is, therefore, a function of the whole length of pipe from E to D, and of the portion between E and C. H.

Eng. Depart. Vanderbilt University,
NASHVILLE, Tenn., June 20, 1888.

EDITOR ENGINEERING NEWS:

In reply to your intimated request for an answer to the hydraulic question asked by your correspondent "*A. B. C.*" in your issue of June 16, please allow me to say that there is both an inconsistency between the two statements of the data of the problem as given in *first* and *fourth* paragraphs respectively of the communication, and in the *first* paragraph an error in reducing the given heads of water to corresponding pressures.

However, leaving these aside and assuming the data as in the fourth paragraph, namely:

Elevation of main at F	00 ft.
Elevation of water surface at D	150 "
Elevation of water surface at E	250 "
Length of $E C$	2500 "
Length of $D C$	500 "
Diameter of all mains	10 in.

and ignoring the influence of bends, gate valves, etc., and assuming that no water is flowing past F, there would result as the elevation of the "Hydraulic Mean Gradient" at the junction, the following:

$$150' + \left[\frac{500'}{2500' + 500'}\right](250' - 150') = 166.7'$$

which corresponds to a pressure of 72.3 lbs. per sq. in. at F.

I have taken no account of the effect of the directions at which the three branches of pipe come together as the necessary data was not given and in any case the effect would be slight.

With no water flowing through $F C$ the pressure at F under the three conditions would therefore be as follows:

A and C open, B closed	65.1 lbs. per sq. in.
B and C open, A closed	108.5 " " "
A, B, and C open	72.3 " " "

Of course it is understood that on opening the valves A and B, the water in the stand pipe and its branch would rapidly fall to a level with the water at D, unless the supply were maintained, so that the condition under which the question is asked could be only temporary. Very respectfully,

OLIN. H. LANDRETH.

[There was another solution published last week. Both appear to us in substance correct. —ED. ENG. NEWS].

Statistics as to the Construction and Maintenance of Highways.

Engineering Department Vanderbilt Univ.
NASHVILLE, Tenn., June 20, 1888.

EDITOR ENGINEERING NEWS:

As you may know, I have been giving the subject of highway systems and highway construction considerable attention during the past year or two, and I am very desirous to collect all available data and statistics bearing on the subject of expenditures for the construction of new roads, and the improvement or maintenance of old roads respectively, including of course the length of highways which such expenditure covers, and the charcter of the construction or improvement. Are you familiar with any collections of statistics on this subject? If so, I should be glad to have you put me on the track of any such information. No reports are made in any of the States to the State Auditors or Comptrollers and the information at the county offices is very largely inaccessible. My purpose in doing this is to formulate a statement showing the inefficient results of our highway systems in the United States as compared with what they might be, and as compared with what many foreign systems now are, under proper rational systems of administration. Very truly yours,

OLIN H. LANDRETH.

The Stampede Tunnel. Northern Pacific Railroad.

[We know of no such statistics, but should be very glad to publish them if we did. Any readers who may be able to send partial information to Prof. LANDRETH, will no doubt assist him.—ED. ENG. NEWS.]

Field-Book for Location and Railway Earthwork.

EDITOR ENGINEERING NEWS:

1. Is WELLINGTON'S "Field Book for Location" to be out this year? 2. What is the latest edition of WELLINGTON'S "Railway Earthwork", and has it any advantages over that of 1875? H.

[1. We fear not in 1889; we shall publish parts of it this year. 2. Latest edition in 1888. It has no advantage over the edition of 1875 except the correction of one or two typographical errors, lower price ($4.00 in place of $5) and furnishing the plates loose in a pocket, in cheaper and more convenient form.—ED. ENG. NEWS.]

A Recent Bridge Failure on the Erie.

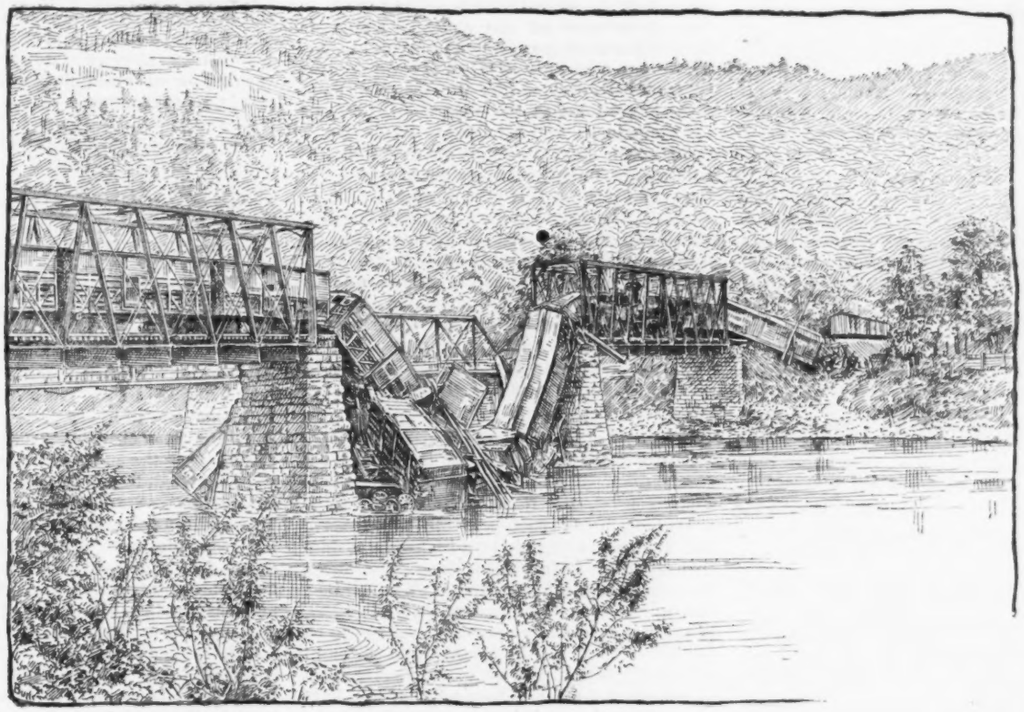
BINGHAMTON, N. Y, June 12, 1888.

EDITOR ENGINEERING NEWS:

I enclose for your edification a view of an accident which occurred on the New York, Lake Erie & Western R. R., at Hancock, N. Y., on June 7. The fallen span, a duplicate of the two left standing, was a rather old iron Post truss, 128 ft. long, center to center. It had a good floor of closely spaced ties with both inside and outside guard-rails and extra stringers under the ends of the ties to support a train off the track. I do not know whether there were snubbing posts on the approaches to protect the end posts or not, or whether Latimer guards were used, but none of these things would have been of any use in this accident. The cause of the failure was a butting collision on the bridge between two freight trains. There went into the hole, besides the bridge itself, two cars of merchandise and three of live-stock. Unfortunately for the poor cattle the trusses were pin-connected. Would a riveted lattice bridge have gone down in such a case?

Yours truly, X.

[We cannot say, but we are confident that any firm of bridge builders which can put up riveted girders of 128 ft. span under a guarantee that they will not fail even when a butting collision occurs on them, will have its hands full of business. Still, we fully agree with the apparent idea of our correspondent that pin connections are not expedient for such short span bridges. ED. ENG. NEWS.]



A Recent Bridge Failure on the Erie.

The Stampede Tunnel.

STAMPEDE TUNNEL, June 6, 1888.

EDITOR ENGINEERING NEWS:

I enclose two photographs of the Stampede Tunnel, which you may find of interest. One [the one engraved] shows the ordinary routine work 4800 ft. from the west portal; the other [not engraved] shows the first break between the east and west headings at a point 5068 ft. from the west and 4776 ft. from the east end. The last shot, fired May 3, 1888, exposed the end of an 18 ft. hole put in from the opposite side.

The total length of the Stampede Tunnel is 9644 ft. The time taken in driving was 27 months. Progress for the months of February, March and April 1888 was as given below, and it is claimed to be the fastest tunneling on record, under similar conditions. The rock was basalt.

Progress of Stampede Tunnel per Month, Average of heading and bench.

1888	East end.	West end.	Total.
Jan.	213 ft.	270 ft.	483 ft.
Feb.	263 ft.	262 ft.	525 ft.
Mar.	259 ft.	266 ft.	525 ft.
April	257 ft.	264 ft.	521 ft.

All under "wall plates".

The alignment checked as follows:

Line 0.046 ft.
Grade 0.03 ft.
Distance 0.6 ft.

Very truly yours,

E. H. MCHENRY, Asst. Eng.

Crushing Strength per Square Inch.

KANSAS CITY, MO., June 20, 1888.

EDITOR ENGINEERING NEWS:

The discussion of carrying power, or crushing of masonry, in your issues of June 2 and since, based on the experiments cited in your columns, seems to lack data on both sides. Perhaps the following may be of interest in the same connection.

Coal so soft that an inch cube of it will crush under a boot heel, is raised from a depth of half a mile or more, where the pressure must be over a ton to the square inch, and it comes out with its internal structure uninjured. Water is drawn from sand and gravel deposits and from fissures, at as great a depth. In railroad tunneling, at a depth of a mile and a half, where the vertical pressure must be over four tons per square inch, rock is found uninjured. With all these, the probability is that the same status exists at depths beyond the reach of investigation.

The canyons of the Colorado, and other precipitous formations, show instances where the supporting power of the rock very near the face of the precipice must be far in excess of any construction man has ever attempted.

In the face of these facts it seems idle to assert that strength does not increase in some ratio with increase of area, and from statistics gathered from such sources rather than from the experiments of a testing machine, it would seem proper to look for the law of increase.

It it doubtful whether any block can be set in a testing machine in such condition as to be certain that it will carry the same load that it will sustain when supported laterally by its fellows in a wall, and also probable that the lack of entire lateral solidity in a well built wall is no greater than is found in Nature's masonry, which may be thus cited as giving reliable data for construction.

Sand in a loose pile will lie at a certain angle, other soils at other angles. Cannot the angle at which solid rock of different kinds will stand be also determined, classing such angle as for 5,000, 10,000 or other vertical height—thus giving us a new basis for the determination of masonry construction?

G. W. PEARSONS.

[Our correspondent somewhat misses the point. It has not been questioned in any of our correspondence (although it has in some absurd reasoning as to the rolling contact of car wheels) that the crushing weight per square inch of all material is much greater in large masses supported on all sides, but only whether *cubes* of constructive material increase in strength per square inch with their size. Our belief is that they do; that a cube of 30 ft. square, for example, would be found to have vastly more strength per square inch than a cube of 1 ft. square. Two series of tests by Gen. GILLMORE seem to prove this directly; one series, recorded last week, seem to disprove it directly. It seems to us that there are special reasons which might explain this apparent contradiction, as there so often are in physical experiments. But whether this be so or not as to cubes, there is no doubt that it is so as to crushing strength per square inch in masses of equal height. [ED. ENGINEERING NEWS.]

THE great reduction in transatlantic steamer freight charges, which has been made in the last decade, is shown by the following comparative rates compiled by *Industries*:

	1881.	1888.
Grain per bushel	$00.19	$0.02
Flour per ton	6.	1.80
Cheese per ton	12.	3.60
Cotton per lb.	⅝ cts.	1/16 cts.
Bacon and lard per ton	10.80	1.80

Both competition and improvements in appliances have helped to bring about this reduction.

THE Pennsylvania Railroad has succeeded in erecting a 55-ton locomotive complete in 16 hours, 55 minutes. Work on it was begun at 7 A. M., June 18, and in less than 17 hours the engine was turned out ready for use. Of course preparation had been carefully made for the feat in advance, but it is a very remarkable one, badly breaking the past record of 24 hours, held by the Baldwin Locomotive Works

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL

Published Weekly at Tribune Building, New York.

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D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Civil Engineers' Society of St. Paul, Minn. – Regular meeting, July 2. Secy., Geo. L. Wilson, City Hall.

Engineers' Society of Western Pennsylvania.—Regular meeting, July 17. Secy., S. M. Wickersham, Pittsburg, Pa.

Ohio Institute of Mining Engineers.—Summer meeting at Logan, O., July 11, 12, 13 Pres., W. H. Jennings, Columbus; Secy. R. S. Weitzel, Kittanning.

New England Roadmasters' Association. – The 6th, annual meeting will be held at Boston, Mass., August 15, 16. Secy.; W. F. Ellis, Roadmaster, Providence & Worcester R. R., Woonsocket, R. I.

American Association for the Advancement of Science. The thirty-seventh meeting will be held at Cleveland, O., from August 15 to August 21, 1888. The headquarters will be at the Hollenden. For particulars address F. W. PUTNAM, Salem, Mass.

Engineers' Club of Kansas City, Mo.—Regular meeting, Sept. 3. Secy., Kenneth Allen, 19 Deardorff Building.

American Society of Civil Engineers, New York.—Regular meeting, Sept. 5. Secy., John Bogart, 127 E. 23d St.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Sept. 19. "House Drainage". Secy., S. E. Tinkham, City Hall.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1122 Girard St.

THE main results of the Nicaragua canal survey, which are chronicled in another column, show that very decided improvements have been effected by the substitution of three more slack-water basins, aggregating 9.68 miles, for an equal amount of canal in excavation included in the surveys of 1885. We are not at all surprised at this result, nor do we see reason to question its practicability, which was suggested in the reports of the former survey and which is apparent from the maps and profiles of the route. The summit level is 150 miles long and 110 ft. above the sea. By a quick descent of 2½ miles on the western end and 3½ miles on the eastern end it descends to the sea level canal dredged in from the coast, which latter is 1½ miles on the western end and 13 miles on the eastern. In these descents are all the 5 locks, (the number having been reduced from 7 to 5) and they are both in the beds of diverted streams. It is now proposed simply to dam these valleys and extend the higher levels further to the coast, so that the natural beds of the valleys constitute the bottom of the canal, or rather slack-water basin. On the middle division a slight gain of 1.45 miles of slack-water navigation, saving 0.93 miles of canal is obtained in a different way, at the loss of 0.55 miles of distance, by following the slack-water navigation in the flooded bed of a stream a little farther than was at first proposed.

The last is of less importance, but the first two are great improvements, adding much to the advantages of the project, which is certainly a most promising and favorable one. There are now only 30 miles of canal proper to construct, divided into five sections; (1) 1½ miles of dredging at the western end followed by some locks and a basin of 4.83 miles of slack water navigation, (2) about 9 miles of summit cut, tapering down each way from 71.4 ft. deep at the center (41.4 to water line) to about 20 ft. at the ends, (3) after 127.32 miles of free lake and river navigation 2 miles of canal followed by 9 miles of basin, (4) the great divide cut of 3 miles in solid rock which is the backbone of the work and contains nearly 8,000,000 cu. yds. of rock; then a basin of 3½ miles proceeded by about a mile of canal at a lower level next to the summit cut, and (5) 13 miles of dredged sea-level canal to Greytown.

PUTTING the main facts of this strikingly admirable location in another way, the great summit level, 110 ft. above sea, and 150.26 miles long in all, reaches within 3.34 miles of the Pacific, where it is terminated by a dam 71 ft. high and about 1,000 ft. long. Two locks then descend to a lower level of about 2 miles, and one more lock descends to sea-level. Both these levels are shown by borings to be earth dredging. On the Atlantic end the summit level extends likewise to within 3.40 miles of the coast flats, but beyond that are 12.95 miles of canal, which borings also show to be earth dredging until very close to the site of lock No. 1. This lock (which may possibly be divided into two) lifts the canal to the Desiado basin, 3.40 miles long, at the end of which lock No. 2, at the east end of the great divide cut, lifts the canal another 53 or 55 ft. to the summit level. Thus there is no canal excavation other than dredging at either end of the great summit level. The serious works are the locks, which it is proposed to make of concrete.

On the summit level there is the great divide cut of 3 miles, then 9 miles of basin, then, in two bits, 2 miles of canal in shallow cut, and then continuous slack water and lake navigation (secured by the Ochoa dam, 61 ft. high) for 122.63 miles. Then succeeds the western summit cut above noted, 8.80 miles of canal carrying the line to the Rio Grande basin of 4.83 miles and to the Pacific locks. It can hardly be expected that further betterments of moment can be obtained on this route. Nature has done about all that can be reasonably expected.

WE shall take an early occasion to discuss this project more in detail, when the definite profiles of the latest surveys arrive, showing the character of the material as determined by borings; but the main facts are already clear. We have no doubt that, apart from the dubious question of the harbor at each end, which, to put in proper condition, may cost some millions more than allowed, plenty of responsible contractors can be found in this country, with both money and reputation to lose, who will undertake to build the canal complete for the face of the previous estimates, some $64,000,000, and make a very good thing out of it at that. This we say as the result of pretty full study of the project, with full remembrance that many of the items of the estimate are quite too low (as notably the railway to precede and aid construction at $16,000 per mile, rock under water at $5, and some other such items) and in the face of the fact that the cost of the Panama canal has so vastly outrun all "estimates". The conditions are radically different in many respects, perhaps the most important of which is that the projectors of the Nicaragua canal have proceeded like sensible men to find out just what could be done before they attempted to do it, instead of rushing in to build first and design afterwards, as at Panama.

THE exhibit which we publish elsewhere of the unfortunate financial condition of the Rock Island Co. is of vital interest to everyone interested in railway matters. The dark prospect for the company's stockholders are fully set forth in Mr. WOODS' report and need not be further referred to. What should be said, however, is that while the ugly features of the case are hardly overdrawn, yet there is considerable reason to doubt the permanence of the causes which have brought about the depression. Rate-cutting is one of these. Eastern investors are out of all patience with the managers of their property in the West who have not only been playing ducks and drakes with the millions of property held by them in trust, but have furnished a bad precedent to the State rate-fixing commissions. It is certain that these great companies cannot long continue this foolish and useless fight. The necessity for their united and harmonious operation has been made so apparent in the past six months that it is altogether likely that it will soon be brought about.

Whether the 10,000 odd miles of new lines which have been added to these Western systems in the past two years are to prove permanently profitable, is yet, as regards many of them, uncertain. Many lines have been built far ahead of present traffic requirements, and there has been no inconsiderable amount of paralleling. But there is good reason to think that the reliance on the resources of the country by the men who have projected and built them will not prove groundless, and that most of them will prove profitable to their owners.

Serious as is the communistic sentiment prevalent toward the railways in Iowa, Minnesota and Nebraska, it cannot be believed that the attempt to confiscate railway property will be successful. The very enormity of the proposition is certain to bring about a reaction against it, and eventually the railway companies will have their right to earn an honest profit on their capital invested fully recognized. Doubtless the days will not return when the companies can pay a steady dividend of 7 or 8 per cent. on a capital of which half or two-thirds is fictitious. Perhaps in the interests of justice they should not. But that the railways of the West will be able to earn a permanent income of 4 to 6 per cent. or more on their actual cost, seems an amply conservative opinion.

WE have just received together the *Transactions* of the American Society of Civil Engineers for December, 1887, and January, 1888. Both are devoted to embalming papers and discussions which were presented precisely a year ago, at the Hotel Kaaterskill Convention. It seems to be one of the laws of nature that such scientific societies shall have their proceedings thus belated, and technical journals which present the substance of the papers

promptly, ought not, perhaps, to complain, since it is decidedly to their advantage to have the official publication delayed, but it certainly strikes one as unbusinesslike and improper, not to say absurd, to have such delay and yet label the pamphlets as for any particular month. If it be impossible to get them out on time, and no doubt there are certain difficulties in doing so, the more sensible way would seem to be to label them simply as for a certain year, and not attempt to make them for any particular month, as is done by the Mechanical and Mining Societies. This is especially so, as the Society derives no benefit from issuing a regular monthly publication under the postal laws. We never have been able to see why the Engineers Club of Philadelphia, Naval Institute, and other such bodies, which issue quarterly proceedings, not open to public subscription in any other sense than are the proceedings of the Am. Soc. C. E., should be able to get pound rates of postage, while the Am. Soc. C. E. has to pay ounce or transient rates. But such is the fact, and as it is so, it would save expense for covers, wrapping and addressing to issue the proceedings in larger packages labeled for the year only. If the proceedings are much more belated, even a yearly date will lose much of its meaning.

IF any of our readers have any information in their possession relating to the expansive force of ice in large sheets, and to what effects it is capable of producing in practice, we shall be glad to hear of them. The point has been raised in regard to the possible effect of such expansive force on the Quaker Bridge dam, but it is also one of general interest in regard to which technical literature is almost silent. We learn from Mr. THOS. C. KEEFER, Prest. Am. Soc. C. E., that he has observed one very remarkable instance of the power of such expansion: An ice bridge of about 90-ft. span between two fixed abutments expanded so from a rise of temperature as to rise 3 ft. in the center, which necessitates an abutment pressure of some 126 lbs. per sq. in., according to hasty, approximate calculations. Such a thrust, if it occurred very frequently, might be a serious matter with a high dam, especially in one which, like the proposed section for the Quaker Bridge dam, has a distinctly "weakest spot" some 70 ft. below the water surface, being much stronger above and below, so that disturbing forces will tend to concentrate their effect there.

The possible limit for the effect of expansion of ice from temperature is of course only some 40°, from, say—10° to + 30°. The coefficient of expansion is not well determined, but it is something like four or five times as great as that of iron, while on the other hand its modulus of elasticity, the other factor which must be taken into account in studying the possible effect of large fields of ice, appears from the very scanty data which are available to be at least considerably higher than that of iron, although it is perhaps not incompressible like water. This being so, whenever the weather grows very cold ice will contract, producing the great cracks and loud reports which almost every one has heard and seen; the cracks will fill up with water and freeze solid, and the next rise of temperature should apparently cause a great thrust on any body like a vertical wall or bluff which opposes a fair resistance to its pressure. The question now is, to what extent have such effects been observed? It is only rarely that the conditions are favorable for observing it at all, and it is worthy of note that the Quaker Bridge will be the first high dam ever built exposed to such possible ice effects, all the others being in warmer latitudes.

THE comparative sections accompanying the communication from Prof. CAIN, which appeared in our last week's issue, bring out in strong light the peculiarity of the proposed section of the Quaker Bridge dam to which we have alluded in the above note; that it is distinctly weaker at about its middle point (above ground) than it is either above or below. We published in our issue of March 3, 1888, a diagram showing precisely the extent of this difference, which is considerable, and it seems to us inexpediently weak there, for so very important a structure, apart from the greater strength above and below which much intensifies the possible evil effect, for the same reason that a 1-in. rod is much harder to break than a 2-in. rod turned down to 1-in. in the center. We are aware that arguments are advanced in favor of the proposed section, but we are unable to see the force of them. We must not be understood to question or deny the safety of the dam as proposed. It might well stand for centuries; but it also might not, and all we claim is that the dam is not so strong as it might be made with the same material differently disposed, or (as respects the section) by a very trifling addition of material at the weakest point, as compared with the great increase of strength.

The principles of sound design in such a matter, it appears to us, were never better nor more succinctly put than by the veracious historian of the Deacon's design for the "one-hoss shay":

"Now in building of chaises, I tell you what,
There is always *somewhere* a weakest spot,—
In hub, tire, felloe, in spring or thill,
Find it somewhere you must and will,—
And that's the reason, beyond a doubt,
That a chaise *breaks down*, but does'nt *wear out*.
—"Fur", said the Deacon, "It's mighty plain
Thut the weakes' place mus' stan' the strain:
'N' the way t' fix it, uz I maintain
Is only jest
T' make that place uz strong uz the rest".

WE are pleased to receive this week the "Memorial Number" of the *International Standard*, the journal founded by Mr. CHARLES LATIMER, devoted entirely to his memory. It uses as a biographical sketch that which we published in our issue of April 7, and contains many tributes of respect and affection in which we heartily sympathize, and but little as to the peculiar ideas to advance which this Society was founded, with which we have never been able to muster up much sympathy. Perhaps the most unique tribute in the whole book is one written in the Chinese language by the scholars of the Chinese Sunday-school class which Mr. LATIMER taught for many years, a literal translation of which is as follows:

"There was one man called CHARLES LATIMER.

"This man was kind-hearted, loving, and more he loved other men than he loved himself. We Chinese men were so fortunate as to have him open a school to teach us the truth of God and Jesus, and we in his school have studied more than ten years. Alas! Mr. LATIMER this year in the third month died.

"All men who saw, there was not one who did not weep, and the faraway ones who heard, there was not one who did not grieve in his heart.

"But this good man having gone to heaven, there is not one who does not still hope that we from all places, kind men, good men, learning of Mr. LATIMER to be good in heart, and to love men, may gain God's blessings.

"Certainly we have hope.

"Fourteenth year of his imperial majesty, Kwang Su, third moon, twenty-sixth day."

Then follow the signatures of 31 of his Chinese pupils. As he was with the Chinese so was he with all men. He was one of the very few of any age or race of whom it can be truly said, "more he loved other men than he loved himself", and to this quality, combined with great natural executive ability, he largely owed his professional success, at the same time that, had he had less of it, his professional success might well have been greater.

A CIRCULAR from the publishing committee, which closes the memorial volume, bears internal evidence that the "International Institute for Preserving and Perfecting Weights and Measures" is likely to die with the death of its founder, as we surmised would be the case, nor do we believe that it will be any great loss to the world if it does. In its appeal for funds the circulars says:

"It was hoped that many local societies would be formed as parts of the Institute, but this was found to be impracticable. There has resulted simply the Institute at large, with a widely scattered membership, and a home society in Cleveland, O., for maintaining the organization and superintending the publication of Institite papers and proceedings. The only other local society is that known as the New York and New Jersey Branch.

"It is probably known to all the members that the Institute has not been self-supporting, and that Mr. LATIMER regularly supplied deficiencies as they occurred from month to month out of his own funds. This source of aid being now cut off, it becomes necessary for us, as members, to distribute the burden among ourselves, and thus make it light to all."

How liberally a lot of members may be expected to rise to this appeal who never thought of exerting themselves to "distribute the burden" during Mr. LATIMER's life, while he was supplying from his scanty means nearly all the money to keep the Society going, may easily be guessed. The fact is, the Society never had any strength or earnestness to speak of, except that which Mr. LATIMER gave it, and although they now propose (if they receive enough subscriptions) to continue the *International Standard* as a quarterly instead of a monthly, there is little likelihood that more than a few numbers will be issued.

WITH this Society will die out all organized opposition to the metric system, and organized opposition is hardly likely to be renewed, certainly not on spiritual grounds. But there is an immense unorganized opposition, both in this country and in England, which will make the introduction of the system very hard. Unfortunately, while the metric system is now nominally (and to a large extent really) the standard of the whole civilized world except the United States, England and Russia, yet that is a terrific "except". The wealth and work-shops of the world are chiefly controlled by the first two nations, and the part they are to play in the future development of the world is even a greater one proportionately. It will be a herculean task to persuade them to incur the very considerable expense and to go through the temporary annoyance of a change to another system, and we fear it will not be done, in our time at least. It is a pity that it should be so, for we can testify from personal experience that it is a matter of a few months only for an ordinarily intelligent person to learn to think and work with metric units, which the simple relation which exists between them greatly facilitates. The system has innumerable points in its favor, and no valid objection against it which experience has ever revealed to us, except the inconvenience and cost of a change. It is a thousand pities that the change to it could not have been made 30 years ago, while modern civilization was in its infancy; and almost as great a pity that it cannot be made now, while civilization is still young. We have no great hope that it will be, but speaking of the matter has suggested to us that it may be well to do what we have never yet done, note some of the pros and cons of the system as indicated by four years constant use of it by an engineer who

had never used it at all, nor given it any particular attention, until he was obliged to, with the English units only fixed in his mind by twenty years of professional work. This we shall do next week.

We are pleased to be again able to record that subscriptions to the KUTTER fund are coming in much more liberally than before. The fund now amounts to $392, as follows, and the end is not yet, we are satisfied:

Previously acknowledged	$323
W. A. N.	10
WM. F. SHUNK	20
GEORGE H. NETTLETON	10
R. P. L., '79	5
Capt. BOURKE, A. N. STALMAKER, E. SAXTON, H. CARTER, B. R. WHITNEY, MATT. HOFFETT, E. A. HARPER, JOHN DONNELLY, WM. B. KNIGHT, G. W. PEARSONS, R. C. PIERSONS, W. KIERSTED, B. L. MARSTELLER, B. R. WHITNEY, JR., ALEX. POTTER, I. H. LASLEY, W. H. BRIETHAUPT, J. A. L. WADDELL, M. N. WELLS, O. B. GUNN, B. W. DECOURCY, J. F. WALLACE, F. L. MILLER, KENNETH ALLEN, $1 each	24
Total	$382

The last three amounts, $39 in all, are a subscription raised by the Engineers' Club of Kansas City. We hope all the other engineering organizations will go and do likewise. As one of our correspondents says: "One who has done so much for engineering should certainly have some recognition from engineers, and the widow of an engineer in trouble should not be forgotten by those who think what such trouble would be to their own family." We can assure our readers that they will rarely have an opportunity to more worthily use any sum from $1 to $100.

Irrigation and the Great West.

We printed last week a brief description of another great irrigating project, this time in Idaho. That it is feasible we have no doubt; that it will go through in time we have as little doubt, and that the successive multiplication of these works, combined with the effect of gradually enlarging the cultivated area of the ground will in time transform nearly the whole of this vast central area of our continent into arable land is as certain as either. It is as to this particular probability that we wish now to say a few words.

Except for the absence from the map of the great mountain chains of the Rockies to indicate the cause, there can be no better opportunity to study the nature and extent of the conditions which make a comparatively arid belt through the west-center of the continent, and to study also the gradual amelioration of the evil which time is effecting, than the general map of the United States showing the progress of railway construction in the past two years, which appeared in our issue of June 16. That time is ameliorating the evil, is especially made very clear.

The whole difficulty arises from the simple fact that the western edge of the continent and the high peaks of the westerly Rockies absorb all the water there is in the breezes coming from the Pacific, so that, by the time the air has passed over the mountains and begins to be heated again it absorbs water rather than precipitates it, and it is not until it approaches the easterly half of the continent that there is water enough in the air for natural rainfall. This evil of course tends to intensify itself; the baking which the soil gets in dry times tends to make its crust non-absorptive when rain does fall, so that it passes off merely in short-lived destructive torrents instead of being absorbed and re-evaporated.

Hence it came about that when the settlement of Kansas and Nebraska first began, the "Great American Desert" extended easterly very nearly to the 98th meridian. West of that, it appeared to be, and was, quite hopeless to attempt to cultivate the soil. How is it to-day? Our railway construction map is the best answer. These lines are not being pushed westward to develop the trade of arid regions, and between the 98th and the 100th meridian has been the scene of the most active railway construction on the continent in the past two years, the area between the 96th and 98th alone excepted. Passing to the 102d meridian we find that there were five lines crossing it in Kansas and Nebraska before 1886, which is an ample number for the mere purpose of transcontinental traffic. In 1886 no new lines were built across this meridian, but in 1887 there were no less than three new east and west lines built across it, not counting the Pan Handle route across the Pan Handle of Texas, which was plainly built to stimulate through traffic rather than local settlement. Besides these, two other lines were built in 1887 reaching out nearly to the 102d meridian, and a third one has been added this year. In all, therefore, at a point about 30 miles east of the 102d meridian there are already 11 parallel east and west lines in a belt 400 miles wide. These must have been built for the most part to seek the trade of the region passed through; and four of them have that resource only, since they do not extend further west.

The large Colorado trade, however, has undoubtedly stimulated this development, and it is doubtless for this reason, rather than from any exceptional sterility above or below this belt, that the last mentioned districts are much less developed. But that the gradual expansion of irrigating operations in the West, and of cultivation in the East, may have great effect upon the climate of the whole region, and probably has had already, is too clear for doubt. In Colorado, during the four years 1881-4, canals were constructed aggregating a flow of over 15,000 cu. ft. per sec., which has been more than doubled since; and each cubic foot per second irrigates from 125 to 150 acres of land. It is to be remembered that the necessary water for irrigating purposes is only some 20 to 24 ins. per year, and often less, practically all of which is returned to the air as vapor. An immense area along the easterly foothills of the Rocky Mountain ranges is directly accessible to irrigation, and this area may be almost indefinitely increased by the construction of storage reservoirs. Further to the east, every square mile of cultivated ground will contribute to the air two or three times as much moisture as it will in its natural state. These causes, if they do not promote rain directly, will have the same effect indirectly, by rendering the air less dry, and it is inevitable that they should gradually ameliorate the climate, and in increasing ratio as the arid area grows less. At least, in no other way does it seem possible to explain the marked extension of the arable area westward.

It is to be remembered that with the ground in a natural condition, as in the eastern half of the United States, the evaporation from the soil is very nearly equal to the rain-fall; for example, the Mississippi river carries off only one-quarter of the estimated rain-fall in its basin; so that no very radical change either way is necessary to transform an uncultivated region into a forest or garden, or into a desert. Let but the natural supply be somewhat over-abundant to begin with, vegetation abounds, and by its evaporation maintains good climatic conditions. Let the natural supply be somewhat scant, vegetation dies out, the ground becomes parched and caked, the water which falls in rain runs off at once, and there is none left to charge the air with moisture again, and thus in the course of centuries the conditions grow worse and worse. Let us suppose that it were possible for a single year to transform the whole arid region of the West into a fertile region by irrigation, and cover half of it with forests. There can be no doubt that it would profoundly modify the climate, and that equal fertility could be maintained thereafter with but a fraction of the artificial water supply. Such wholesale change is impossible, but it is not impossible to gradually approximate to the same effect, and that the result will be the same a century hence seems more than probable.

We cannot believe, therefore, that the tremendous contrast in density of population and mileage of railways which now exists between the eastern and western halves of our country will always exist, and we look with confidence to see the net-work of railways continually extend itself westward. It is even claimed with some plausibility that these railways have a direct effect upon the climate by modifying its electrical condition, and there are many facts which support this view as well as some which controvert it. There is certainly the effect from some cause, whether it be the railways, or the cultivation of the ground or of trees, or of all three together.

The probable course of events in this Western area is therefore, that year by year the area of irrigated land will increase by building the more easily constructed works; that as these proceed the admissible expense for irrigating less conveniently located land will increase, and with it the irrigated area; that there will be a gradual encroachment from all sides on the sterile area, an evening of the rainfall, if not an increase; and that finally the whole region will be filled with a large population and many railways.

Foreign Notes by Rail.

(EDITORIAL CORRESPONDENCE)

A trip over the lines of Central and Northern Italy, across a corner of Austria and through Bavaria and Wurtemberg, in Southern Germany, gives one a considerable variety of experience. In Italy, while the second-class carriages are fairly comfortable and good enough for short trips, the third class vehicles are to be scrupulously avoided, unless the traveler enjoys hunting the active little "Italian chamois" which Mark Twain found so abundant in that classic region. Contrary to the usual idea the lower classes in Southern Italy seem no more ragged and dirty than in other parts of the Continent, and are far less miserable in appearance than the poor of London and Paris, for their faces are bright, and they seem to enjoy well the little they have. But there is a something in the soil, climate or surroundings that does breed vermin, and after a few days sight-seeing, about Naples for example, the tourist feels an irresistible longing to hunt for that particularly aggravating animal which he is sure is somewhere concealed about his person. It is usually, not always, a false alarm, but the impression is fearfully realistic. Hence the wise man avoids the third-class carriages and the people that frequent them; in the second-class the danger is not so imminent, and the Italian is above all things economical, and the best of the people rarely indulge in the extravagance of a first-class ticket on the railway.

A brief acquaintance with Austrian accommodations would lead one to class them in the same category with the Italian, but in Southern Germany the case is very different. About Munich, and in fact on to Strasburg, the third-class carriages are very clean and seem to be the favorite for all short trips. For long journeys, the uncushioned seats and vertical wooden backs would make them uncomfortable. In this section of the country the second-class carriage is very good and the first-class almost luxurious.

As to railway fares in the sections referred to, we may compare France, Italy and Southern Germany about as follows, taking a distance of 100 kilos., or

62 miles, as a standard in each case and reducing the money to an American basis:

	1st. Class	2nd. Class	3rd. Class
Germany	$2.00	$1.33	$0.85
Italy	2.24	1.57	1.01
France	2.46	1.85	1.36

These are rates taken somewhat at chance from the railway guide-book of the several countries; but while they differ slightly even in the same State, the proportions seem to hold good between the nations quoted. The wide margin between the first and third-class rates in all cases explains the preference for the lower price among people who look upon their money unit, which is a piece worth 20 or 25 cts., very much as Americans do upon their dollar unit. And the odd thing about this variation in the unit value is that the traveler in Southern Europe soon falls into the country habit and views with alarm, and as almost extortion, a bill which would be remarkably low if presented in American dollars on American soil. In Munich we were charged with undue extravagance by some American art-students for spending 25 pfennigs (about 5 cents) for a cigar, whereas the height of their expenditure for the weed was 7, and more usually 5 pfennigs. It may be added in self-defence, however, that the 25 pfennig cigar was none too good. Beer is the only really exceptionally good and remarkably cheap thing in that old German town, and if the statistics given tell the truth, it is appreciated accordingly, for the 200,000 inhabitants of the capital of Bavaria are said to demand 28,000,000 galls. per annum for their own use.

To return from beer to the railways, which are largely devoted thereabouts to transporting that fluid to other less favored regions, they are well built and well cared for, and near Munich, and particularly between Nuremburg and Stuttgart and on to Strasburg, there are long lengths of line laid with metal ties of the rolled steel type most familiar to engineers, and with the ends closed by either cutting and turning down, or by riveting in a section of angle-iron. The short rails, which have been before mentioned as noticed in France, were also being removed, and a heavier and longer (30-ft.) rail substituted for them. It is interesting to observe how the short four-wheeled Continental car is adapted to the transport of 60-ft. sticks of timber from the Bavarian forests. The trick is simple enough; each car is transformed into a truck by pivoting in the center of each car floor a heavy framework of iron with uprights which carry the timbers clear of the car. The sticks are secured to this frame and in themselves form the coupling between the cars, which latter may be 20 ft. apart.

Among other novelties noted along the railways were iron telegraph poles made of a 6 × 2½-in. beam set in an artificial stone base about 20 ins. square and 4 ft. deep; the insulators were carried on angle-iron cross-arms, the only case on the Continent where we noticed cross-pieces at all. As in France, the usual telegraph pole is made of a round stick about 7 ins. in average diameter and when the number of wires or curves require it, this

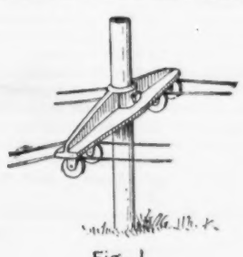

Fig. 1

pole is braced with another striking it near the top; or two vertical poles are used connected by a horizontal cap, and both poles are strung with wires carried on an insulator supporter, which is a semi-circular iron spiked to the pole. Signalling apparatus is extensively used and the signal wires run for long distances alongside the track. These wires are commonly carried on stout wooden posts and over or through pullies, as with us; but the support varied on different lines. One of the most complete is shown in Fig. 1, in which the casting was adjusted to the proper height above the ground by slipping it along the vertical pipe-support and fastening by a set-screw. The simplest device was that shown in Fig. 2, which was made by taking a

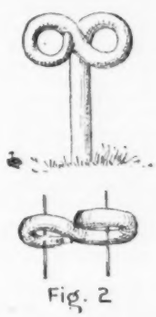

Fig. 2

double twist in a ½-in. round iron rod as shown, and leading the wires (only two in this case) through these turns; the bends in the rod do not touch but are slightly separated as shown in the sketch, so that the *ends* of the wires need not be passed through the holes.

All through Italy and Lower Germany grade crossings are abundant outside of the towns, though they are avoided if any reasonable expenditure will permit it. But at each crossing, no matter how remote from habitations, is a keeper, very usually a woman in Italy. As the train approaches, these keepers close their gates and assuming a military attitude, face to the front and salute with their signal flag, carefully rolled up and enclosed in a round copper cylinder when all is well. The gates closing these crossings vary much in their type. In Italy, old rails are often utilized for this purpose, one length spanning the road and two short sections acting as a brace and end upright, pivoted at top and bottom to a stone post; these old rails are also used for fencing in depot grounds. In Germany, a very usual form of gate is a long wooden stick pivoted over a stone block and another stone block bolted on the short arm as a counter weight. Instead of the gentle caution to "Look out for the Locomotive" the German railway officials use the sharp military command of "Halt", and halt you must, at a considerable distance from the gate.

As far as a single traveler can judge, the European railway official is very obliging and polite, made to answer the numerous queries of often bewildered or stupid travelers, native and foreign, and to render every assistance in his power. In Germany, these men are very often old soldiers and some of them proudly wear as many decorations as a New York State Militiaman on parade, though they usually mean more serious service, as the Iron Cross, of 1870-71, indicates. Their uniforms are military and often very handsome, and their bearing is that of a soldier. This latter fact is not very remarkable in a country where every able bodied man must do his term of service, whether he will or no, and where every city and considerable town resounds with the tramp of armed men, and the streets and cafés swarm with the trim-looking officers, who may at anytime be called upon to lead them to battle with the neighbor across the way.

While it has nothing particularly akin to engineering one cannot help remarking that it is a perpetual wonder where the money came from, in Italy for example, to arm, equip and support the hundreds of thousands of men there withdrawn from the channels of industry, and to put afloat one of the most powerful, if not the best armed fleet of war vessels in Europe. Italy claims to have a standing army of over 700,000 men, actually in service, second only to Russia in numbers. And while we may doubt the statistics, the fact is everywhere apparent that soldiers abound and that some one "must pay the piper". The condition of things today is all the more remarkable when we consider that but little more than 20 years ago Italy had no standing as a nation among the Powers of Europe, and its territory was only something to be fought over between Austria and France. Italy's credit is good enough to keep its paper currency almost on a par with gold, and she is much better off in that respect than her old Austrian masters; her commerce is increasing, public works go on on an extensive scale; her cities appear to the stranger to be well governed and the whole land smiles; but how she does all this and yet wastes so much bone and sinew upon the armies and finds the means to keep these armies in practical idleness, is what puzzles the American. Italians say that if they disbanded their army and stopped putting constantly bigger guns on better ships, some one of their neighbors would step in and assume control; and that their present existence and all that the future may have in store for them depends upon the strength of their watch dogs as compared with the dogs of two or three other nations close at hand. This seems to be the controlling feature in European politics now, as it was centuries ago in the more widely scattered and individual cases of the robber-knights of the Rhine, who considered all his that his right arm and blade or lance could gather in. America has had her troublesome times; but just now, with the disposal of a surplus revenue as her chief national ailment, can well afford to smile at the condition of affairs across the sea; or, at least, congratulate herself that this sea serves as so sufficient a substitute for a standing army.

PERSONAL.

Col. G. E. WARING is arranging to put in the "Waring" system of sewerage at San Luis Obispo, Cal.

GEORGE F. LEE has been appointed District Passenger Agent of the Baltimore & Ohio Railroad.

G. W. CUSHING, Superintendent of Motive Power and Rolling Equipment, Philadelphia & Reading R. R., will resign July 1.

J. M. RIDENOUR was on Friday last elected one of the directors of the Cincinnati, Hamilton & Indianapolis road for the thirty-eighth consecutive year.

WEBSTER SNYDER, General Manager of the Gulf, Colorado & Santa Fé Railway, has tendered his resignation, to take effect Aug. 1.

JAMES RYAN, of New York, masonry contractor of the Poughkeepsie bridge was killed June 26, by the breaking of a derrick chain on the west shore at Poughkeepsie.

ALFRED BISHOP MASON has been appointed Vice President of the Jacksonville, Tampa & Key West Ry. He will have charge of the affairs of the company in Florida.

C. H KENDRICK has resigned the auditorship of the New York Central Railroad. He has held the position for 20 years, and has been very popular among the employés of the road. He was formerly general passenger agent of the road in which position he was succeeded by C. B. MEEKER.

D. C. BEVARD, formerly trainmaster of the Kansas Central Railway, has been appointed Assistant Superintendent of the Kansas division of the Union Pacific Railway and branches east of Brookville, vice Mr. W. Y. CARLTON, resigned.

C. O. JOHNSON, Division Freight Agent at Memphis, of the Gulf system of roads, has resigned, to take effect July 3, and will accept a prominent position with the St. Louis, Arkansas & Texas Railroad.

JAS. C. ANDERSON, General Passenger Agent of the New York, Ontario & Western Railroad was married on June 27 to Miss CHARLOTTE LOW, youngest daughter of HENRY R. LOW, President of the Port Jervis Monticello & New York Railroad.

C. M. CRAWFORD, Chief Engineer of the Meriden & Cromwell R. R. Co., has been appointed Superintendent of the road, which has been reorganized as the Meriden, Waterbury & Cromwell R. R. Co.

HORACE C. BALDWIN, Assistant City Engineer of Yonkers, N. Y., died in that city on June 17. Mr. BALDWIN was born in Nashua, N. H., in 1848. He began the practice of civil engineering in Yonkers in 1870, and was afterward a resident of Flushing, L. I. He was at one time engaged on railway construction in Mexico and New Mexico.

JOHN E. MCGRATH, one of the youngest assistants of the United States Coast and Geodetic Survey, who has had charge of the transcontinental geodetic leveling east of the Rocky Mountains, has arrived upon the Pacific coast. Superintendent THOM has assigned him to the topographical party of Assistant RODGERS, now operating in Southern California, with his camp at Oceanside.

EDMUND SMITH, who has resigned his position as First Vice-President of the Pennsylvania road, entered the service of the company as rodman and has since been division superintendent, secretary, treasurer and vice-president, his service covering thirty-seven years.

HON. G. W. ROSS, Minister of Education of Ontario, and Professor J. GALBRAITH, M. I. C. E., of the Toronto School of Practical Science are visiting the principal engineering schools in Pennsylvania, New York and New England with a view to the introduction of improved methods of instruction in the engineering school at Toronto.

G. W. BENTLY has resigned the office of General Manager of the Jacksonville, Tampa & Key West Ry. and the office has been abolished. W. L. CRAWFORD, the Superintendent, will have charge of the operation of the road with L. E. BARKER as General Freight Agent and G. D. ACKEELY as General Passenger Agent.

E. DARRACH, Mining Coal and Freight Agent of the Reading Railroad has tendered his resignation to take effect June 30. Mr. DARRACH has been in the employ of the company for 27 years and has occupied his present position for the last 16 years.

THOMAS F. GORDON who has been Secretary of General Freight Agent SPRIGGS, of the Nickel Plate ever since the road has been in operation, has been appointed commercial agent of the new Interstate Dispatch, with headquarters at No. 347 Broadway, New York, taking effect July 1.

The Panama Canal.

AN abstract of the articles in ENGINEERING NEWS of June 2, on the present status of the Panama Canal, was cabled to the Panama *Star and Herald*, which is of course highly friendly to the canal, and it publishes in response the following article in its usual polyglot fashion, French, English, and Spanish:

AN EXAGGERATED ARTICLE.

As our readers will perceive in the appropriate place of this issue, the cable has brought us an extended *resumé* of an exaggerated article on the Panama Canal, published by ENGINEERING NEWS, of New York.

Aware as we and our readers are of the hostility in America against the Panama Canal, for reasons which we have exposed on not a few occasions, we nevertheless feel it incumbent to show wherein the article in question, that is, such of it as the cable has brought us, is unreliable, sensational, and wholly and solely exaggerated. We need hardly concern ourselves with the motive of the writer of the article, but being on the spot, and therefore having all the facilities of getting at the actual state of affairs, it serves the purpose better, in view of the reputation enjoyed by ENGINEERING NEWS, to deal with facts, making only the most conspicuous deductions.

The aggregate amount of cubic meters left to be excavated up to March 25, 1888, was less than 31,000,000, including the canal, the deviations and accessories, and not 50,000,000, as announced by ENGINEERING NEWS.

In order to accomplish its object the company excavated since Jan. 1, 1888, at least 1,250,000 cu. m. per month, and to maintain this rate during the rainy season, the company will have, in two months, eight more dredges, which will enable the total excavation to amount to 15,000,000 cu. m. for 1888. The amount in 1887 was 12,000,000. Before the end of 1888, ten other new dredges will be added to the company's force and will undoubtedly bring the total excavation per month to 1,500,000.

Even making abundant allowance for unforeseen circumstances, the figures we have just quoted show beyond doubt that the year 1890 will be more than sufficient for the completion of the canal, and that, therefore, the writer in ENGINEERING NEWS is guilty of exaggeration in estimating four years to be necessary for that purpose.

The estimate made in the same journal puts the average cost for excavation per meter at 22 frs. 55 c. [$4.50]. This is probably an error of the cable. We estimated $3.50 and used only $2.50 in reaching our estimate of $240,000,000 more as that requisite to finish the canal.—ED.] Perusal of the contracts that the company has entered into is sufficient to disprove this statement, and it is moreover to be borne in mind that all the expenses for materials have already been made.

In fine, on January 1, 1888, the total excavation of the Canal and the deviations amounted to almost 40,000,000 cu. ms., and that remaining to be done was 28,000,000. The comparison of these figures suffices to show the exaggeration of the article in ENGINEERING NEWS.

It is therefore absolutely reasonable to count on the opening of the Canal on the lock system in the course of the year 1890, and at no greater cost than the amount now asked for by the Company.

We need only add that "perusal of the contracts" of earlier date would likewise show very different figures from those of the actual cost. We may perhaps add that we have taken the proper steps to obtain if possible official data as to the proposed plans for controlling the Chagres, as to the actual state of the progress profile to date, etc., but hardly expect to secure them.

An Attack on the Nicaragua Canal Project.

A correspondent of *The Engineer*, from Nicaragua who appears to be an ex-member of the surveying party sent out Dec. 1 last, makes the following statements:

"As to Greytown Harbor, formerly ships used to sail right up to Greytown; but now they have to anchor inside the bar, which is some 6 miles from Greytown; when the weather is at all rough it is impossible for the steam tug to go off to the ships to take the cargoes up to Greytown. The whole of Greytown Harbor is silted up, the bed of the sea within miles of Greytown is shifting sand, and I am confident that it would take millions of money to ever make a passage for ships to enter the proposed canal; in fact, it is questionable whether the harbor can ever be made navigable again. For 40 miles round Greytown it is a perfect swamp. On the 16 miles that I located, I reported that I considered it impossible to make a canal through the country. There are plenty of hills quite as formidable as any on the Panama Canal. Again the survey made by MENOCAL in 1885 is all nonsense; Mr. MENOCAL and his two assistants made nothing but a flying visit through the district, during the short time they were in the country. Again, the surveying party that is now engaged, found very serious obstacles at the Divide. I may here say that it rains ten months in the year in Nicaragua.

"There are large numbers of watercourses, lagoons, etc., to provide for. There are no materials in the country suitable to build the locks with. The present company is composed of a few stockbrokers, who subscribed $225,000., of this sum $100,000 was paid to the Nicaragua Government for right of way. Each chief of party was assigned two newspapers to write to, to puff up the scheme. The president of the company gave strict instructions to the chiefs of parties not to publish any accidents that may happen to the expedition, or the amount of sickness among the members. I may say at once that the whole affair is a Yankee bubble; the people that the company expects to snare are the English and German. —S. M."

THE animus of the communication is apparent and some of its statements betray great ignorance, as for instance that it is impossible to make a canal through a swamp. If the alleged orders as to correspondence were in fact issued ENGINEERING NEWS has been singularly unfortunate, as we endeavored to arrange for regular advices, and have published one or two letters from there, but certainly not devoted to puffing the enterprise. That there is liable to be trouble with Greytown harbor, and that there is a great deal of rain in Eastern Nicaragua, is, we believe, true. The remainder of the letter we take to be either irrelevant or untrue.

THE trustees of the estate of JAMES LICK have turned over the Mount Hamilton Observatory complete to the Board of Regents of the California State University. The instruments in the observatory alone cost upwards of $200,000. $590,000 have been expended for the erection and equipment of the observatory. The new hydraulic ram, used as an additional power to raise the movable floor of the dome is found to work without the least noise or jar. A newspaper report states that owing to the intense dryness of the atmosphere the slate roofs on the buildings are beginning to crumble and that the slate is to be replaced with copper, which is expected to prove more durable. The sum of $20,000 a year has been set apart by the Regents for the maintenance of the observatory.

PUBLICATIONS RECEIVED.

Ohio Society of Surveyors and Civil Engineers. Ninth annual report, being the transactions of the Society at its ninth annual meeting, held in Columbus, O., Jan. 10, 11, 12, 1888; with other valuable matter: 273 pp. 50 cts.

The reports of the committees on Legislation, Highways, Civil Engineering and Land Surveying are given; also the following papers: "Judicial Functions of Surveyors", HOMER C. WHITE, Warner, O.; "Difficulties of Surveying in the Virginia Military Lands", WM. REEDER, Co. Surveyor of Madison Co.; "Adverse Possession", E. D. HASELTINE, Co. Surveyor of Mahoning Co.; "Road Making Materials of the State", Dr. E. ORTON; "Notes on Paving", THOS. R. WICKENDEN, Toledo, O.; "Street Pavements in Cleveland", M. E. RAWSON, Asst. City Eng., Cleveland, O.; "Street Crossings and Sidewalks", R. A. BRYAN, Portsmouth, O.; "Monuments", F. HODGMAN; "The Public Domain", J. T. BUCK, Cardington, O.; "Two-Mile Assessment Pikes", E. W. DIMOCK, Dupont, O.; "Construction of Turnpikes", G. S. INNIS, Columbus, O.; "Philosophy of Underdrainage", JONATHAN ARNETT; "Catfish Drainage System", F. M. KENNEDY, City Eng., Washington C. H., O.; "Construction, Comparative Cost and Efficiency of Tile Drains and Open Ditches", E. B. OPDYCKE; "Irrigation in Kansas", J. S. HUMPHREY, Garden City, Kan.; "Importance of Water-Works and Pure Water for Cities and Villages", J. B. STRAWN, Salem, O.; "Circleville Water-Works", W. C. ROW; "Construction Maintenance and Repair of Short Span Highway Bridges" S. A. BUCHANAN, C. E., Bellefontaine, O.; "Calculation of Strains in Trusses of Highway Bridges", C. N. BROWN "Raising and Moving Bridges", THOS. H. JOHNSON "Pile Foundations", JULIAN GRIGGS; "Necessity of Piling in County Bridges", F. M. DAVISSON; "Mortar-Making and Using", B. F. BOWEN; "Landscape Engineering", JOHN L. CULLEY; "Outfit of a Railroad Engineering Corps, and Conduct of the Survey", BENJAMIN THOMPSON; "Railroad Location", S. F. ROCK; "Duplication of Drawings", Jos. N. BRADFORD; "Use of Steel Tapes in Surveying", J. B. JOHNSON.

Some Details of Water-Works Construction. By Wm. R. BILLINGS, Supt. Taunton, Mass. Water-Works. New York, Engineering and Building Record, pp. 96, 8vo., 2 cuts, no index. $2.00.

This volume is well described by its title. It does not pretend to be a complete treatise but contains many useful practical notes, the result of a long experience.

Forty-First Annual Report for the Year 1887 *of the Board of Directors of the Pennsylvania Railroad Company to the Stockholders.* Published by the Company. JOHN C. SEMIS, Jr., Secretary. 233 So. 4th St., Phila. Pamphlet 9¼ × 11¼ ins. 58 pp. Two excellent maps.

It is not every railroad company's report that can be classed as a publication; but the pamphlet before us which refers to a railroad system comprising 7,485 miles of railroad and 12,130 miles of track, with a capitalization of $228,715,000, contains matter of interest to others besides the holders of the company's securities. The following is the summary of the results of operations on the whole system for the past two years:

	1887	1886	Increase.
Gross earnings	$115,515,506	$101,697,980	$13,817,525
Expenses	77,238,082	67,102,714	10,135,367
Net earnings	38,277,423	34,595,266	3,682,157

FREIGHT TRAFFIC.

	1887	1886
Number of tons moved	106,128,215	96,768,381
" " ton miles	9,822,067,034	8,690,844,488

PASSENGER TRAFFIC.

	1887	1886
Number of passengers	68,153,705	60,466,278
" " passenger miles	1,382,772,904	1,259,287,645

On all lines east of Pittsburg and Erie the average expense of transporting a ton of freight a mile was $\frac{.925}{100}$ cts. and the average earnings from the same were $\frac{.740}{100}$ cts. On the same lines the average revenue per passenger mile was $2\frac{.855}{100}$ cts. and the cost of transportation was $1\frac{.877}{1000}$ cts. On these lines a comparison between the local freight and the through freight showed that the former comprised 87.45 per cent. of the whole.

Tenth Annual Report of the Iowa Board of Railway Commissioners for the year ending June 30, 1887. Published by the State. 6 x 9 ins. 927 pp., cloth bound, many tables, and large State map showing different systems in colors. The advance sheets of this volume, which were issued in pamphlet form, were reviewed in our issue of March 10, of the current volume. The additional matter in the present volume consists principally of tabular reports, digests of judicial decisions etc. The volume as a whole does much credit to the commissioners of whose work it presents a record. There is abundant reason to believe that the commission now in power in Iowa will do much more for the discredit of the State and much less for its benefit than was done by Messrs. DEY, COFFIN and SMITH.

The Proceedings of the United German American Technical Societies. A neat volume of about 100 pages.

Aside from the regular reports, minutes etc., it contains a report of Mr. KURTH, Chairman of the Committee on National Public Works, with papers on heating cars by steam, determining graphically the maximum forces in trusses, removal and utilization of City sewage, and a paper by Mr. FABIAN relating to the theories demonstrated by him to have mainly led to the dangerous state of the large vault over the Assembly chamber at the Capitol at Albany, which Mr. FABIAN foretold.

The publication is a very creditable one to the Society.

Tables for Field Engineers. Designed for Use in the Field, Containing all the functions of a 1° curve, from which a corresponding one can be found for any required degree. Also, Tables of Natural Sines and Tangents. By AMOS STILES, C. E. New York, D. Van Nostrand. Pocket-book 156 pp., 16 pp. text. $—

Besides the tables named there is a table of radii "and their logarithms" although of what use these logarithms can be without a table of logarithms also does not clearly appear. The logarithms also are the inconvenient 6-place, which should be wholly dropped in favor of either 5-place or 7-place. The typography is clear, and the tables are very useful ones.

Institution of Civil Engineers.—The following are the latest papers received: "Manganese Steel", by R. A. HADFIELD; (128 pp.). "Machinery for the new Steel Works at Terni, Italy", by HUGH SAVAGE; (17 pp.). "Paved Carriage Ways in Sydney, New South Wales", by A. C. MOUNTAIN; (22 pp.)

Journal of the New England Water-Works Association. June, 1888. This number contains a paper on "The Biological Examination of Water", by WILLIAM T. SEDGWICK, Ph. D., Prof. of Biology in the Massachusetts Inst. of Technology. There are several discussions on this subject and also on the subject of "Water Waste during Cold Weather". This number also contains a table of water-works statistics in the form adopted by the Association. Price 75 cts.

Proceedings of the U. S. Naval Institute.—No. 2, 1888. This last issued number of the Proceedings, contains the following papers: "Notes from the Journal of Lieut. Craven, U. S. N., Pacific Squadron, 1846-49"; "Reducing Chronometrical Longitudes"; "Three considered as a Tactical Unit", with discussion; "Velocities and Pressures in Guns", "Ignition of Explosive Gases by Broken Incandescent Lamps"; "Notes on the Literature of Explosives". There are also notes on steel; the Riehlé hydraulic testing machine; liquid fuel for torpedo boat boilers; and gun making in the United States.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—The Club has adjourned its meetings until Saturday, October 6, 1888. At the meeting of June 16, Past-Prest. THOMAS M. CLEEMAN in the chair: 22 members present. Messrs. HENRY ROESKE, WM. W. THAYER, J. H. SKINKER, JAS. S. MERRIAT, HENRY G. MORSE, JNO. M. CAMERON, T. R. HALL and W. H. PRATT were elected Active Members.

The Secretary presented communications from the Engineers' Club of Kansas City, dated May 14th, 1888, and from the Western Society of Engineers, dated June 13th, 1888, asking the co-operation of the Club in efforts to properly regulate, by law and otherwise, the design and inspection of highway bridges. A committee of three was appointed, consisting of Messrs. H. B. SEAMAN, Chairman, WM. H. BURR and HENRY G. MORSE, to co-operate with the committees of the above named Societies.

The Secretary called attention to the proposed publication, by Mr. FRANCIS F. GALLOUPE, M. E., 30 Kilby St., Boston, Mass., of an Index of Engineering Articles, which have appeared, 1883-7, inclusive, in many of the leading American and English Engineering journals.

The Secretary reported from the Board of Directors that, at the suggestion of Mr. JOHN C. TRAUTWINE, Jr., they had considered the propriety of a gift by the Club to the family of the late W. R. KUTTER, who have been left without means, as a memorial of our appreciation of his great service to the profession by his original research in hydraulics, and moved that the Board be authorized to appropriate $100 for this purpose, which was unanimously adopted. [The money has been duly orwarded to this journal to add to other subscriptions, and acknowledged. ED.]

The Secretary called attention to various suggestions which had been made as to the best form in which to continue the publication of the Club Reference Book—and the subject was referred to the Board of Directors, with power to act.

Mr. E. F. SMITH presented, for Mr. H. M. SPERRY, an illustrated description of a Method of Displaying Titles on Blue Prints, by writing the title, number, etc., along *both* ends of the tracing, and, when printed, folding each end of print backwards, in a fold about one-half inch or so wide, and pasting it, back to back, so that when the print is on file, rolled, its title will always appear on the outside.

Mr. E. F. SMITH presented a very completely illustrated paper upon Dam Building in Navigable Streams.

Prof. J. W. REDWAY read a pa er upon the Hydrography of the Mississippi River.

The Secretary presented, for Mr. RUDOLPH HERING, a Formula for the Mean Velocity of Flow in Sewers, being a simplification, for field and general use, of KUTTER'S Formula.

Ohio Institute of Mining Engineers.—The summer meeting will be held at Logan, O., beginning July 11. On Wednesday, July 11, the session will be opened by W. H. JENNINGS, and a paper will be presented by Prof. N. W. LORD on "School of Mines at Ohio State University". On Thursday, July 12, the following papers will be presented: "History of Mining Legislation in Ohio" Hon. ANDREW ROY; "Shaft Mining in the Sunday Creek Valley", J. J. DUN; "Fire Clays of Five-mile Creek Ellis JOYEJOY; "The Grading of Pig Iron", EDWARD ORTON, JR. Other papers have been promised, and an interesting discussion on Brick Paving is expected. A business meeting will be held for the election of new members. An exhibition of mining views, by the stereopticon will be given by Prof. N. W. LORD in the evening. On Friday, July 13, there will be an excursion to the mining regions at Brush Fork. THOS. B. BANCROFT, of Columbus, O., is Secretary and Treasurer.

Rensselaer Polytechnic Institute.—The sixty-fourth commencement exercises of the Rensselaer Polytechnic Institute took place at Troy, N. Y., on June 13. Thirty-one graduates were given the degree of Civil Engineer and one received that of Bachelor of Science. An address entitled "The Era of Engineering" was delivered to the graduating class by Com. B. F. ISHEWOOD Chief Engineer, U. S. N.

At the Alumni meeting the following officers were elected for the ensuing year:

T. GUILFORD SMITH, class of 1861, *President*; WM. METCALF, class of 1858; CLARK FISHER, class of 1858; J. J. ALBRIGHT, class of 1868, *Vice-Presidents*; WM. P. MASON, class of 1874, *Secretary*; C. W. CROCKETT, class of 1884, *Cor. Secretary*; TOWNSEND V. CHURCH, class of 1881, *Treasurer*; F. COLLINGWOOD, class of 1855, JOHN SQUIRES, class of 1869; A. C. SHAW, class of 1877, E. C. GALE, class of 1883, *Directors*.

On the suggestion of Prof. MASON a resolution was adopted to build a fire-proof building costing $20,000 to receive the mineralogical collection recently presented by Prof. MASON. The library and the unique and valuable geological collection made by Prof. HALL, State geologist, are now tendered by him to his Alma Mater on condition of the erection of a structure suitable to receive it. One quarter of the amount required was subscribed by the Alumni on the spot and Mr. JOHN H. PECK, the new President of the Institute, predicted that the corner stone would be laid next year.

At the Alumni dinner, Past-President THEODORE VOORHEES presided; State Engineer JOHN BOGART, responded to the toast, "Engineering:" Col. J. W. WHITTEMORE, U. S. A. spoke for "the Army;" Capt. CLARKE FISHER for "the Navy" and Hon. MARTIN L. TOWNSEND for "the Law". Toasts were also given to President PECK, the City of Troy, the Faculty—the Graduating Class and the Class of 1868, whose members held a reunion at which nine out of seventeen living members were present.

The Pittsburg chapter of the association of graduates has invited the members of the Alumni to the winter re-union to be held in that city in February next.

American Association for the Advancement of Science.—The thirty-seventh meeting will be held at Cleveland, O., from August 15 to August 21, 1888. The headquarters will be at the Hollenden. For particulars address F. W. PUTNAM, Salem, Mass.

Engineers' Society of Western Pennsylvania.—At the regular meeting held June 19, communications were presented from the Western Engineers' Society of Chicago and the Engineers' Club of Kansas City relating to the appointing by the State of bridge inspectors and to the construction of bridges by irresponsible parties. The paper on Steel Plates read at the last meeting by Mr. WM. E. KOCH was taken up for discussion, and Mr. KOCH was asked why he considered American plates superior to English when the cross-cut test was applied.

He answered that in England the length of the steel slab was the width of the rolled plate, the steel being pulled out in one direction. In America the steel is rolled from the ingot and drawn through the rolls straight and also cornered. It is pulled out in all directions and the result is a plate which will test almost the same either lengthwise or crosswise.

Mr. JACOB REESE objected to the statement that a Frenchman invented the Basic process, and produced proofs that it was his own invention. The use of steel in bridges was discussed at length, the general opinion being that it would be best to stick to iron for some time yet.

A resolution favoring the establishment of a technical school in connection with the University of Western Pennsylvania was offered by Capt. A. E. HUNT.

The death of DAVID SMITH was announced and the Chair instructed to appoint a committee to prepare a suitable minute.

By a rising vote the Secretary was instructed to give to Mr. BRASHEAR a letter of introduction from the Western Pennsylvania Society to the engineering societies of Europe.

The Society adjourned to meet next September.

Holly Steam Engineers.—The Holly District Steam Engineer's, Superintendents' and Managers Association held its third annual convention at Springfield, Mass. June 22, and elected the following officers:

President, R. H. GALLAGHER, Harrisburg, Pa.; First Vice-President, C. E. EMERY New York; Second, E. P. HOLLY, Springfield, Mass. Third, G. W. SHOUCK, Wilkesbarre, Pa.: Fourth, WILLIAM RIDLEY, Denver, Col.; Secretary, IRA A. HOLLY, New Haven: treasurer, ROBERT MOWBREY: Financial Committee, A. Z. SHOCK, Bloomsburg, Pa., J. D. WALSH, of Lockport, N. Y., and A. D. MERRITT, Springfield.

The following papers were read and discussed: 'High and Low Pressures for Heating Buildings from a Central Station", by R. H. GALLAGHER, Harrisburg, Pa.: "Crude Oil and Coal Compared as Fuels", by E. P. HOLLY; "Can Cooking be done economically by Steam?" by CHARLES S. CHASE, New York: "General Management of the Holly Steam Plants", by A. Z. SCHOCK, Bloomsburg: "Incrustation in Boilers", by WILLIAM RIDLEY, Denver, Col. "Is it Advisable to Heat Feed Water by Direct Steam" by B. C. SMITH, Auburn, N. Y.: "Cost of Maintaining Steam Meters" by JOHN WALSH, Lockport, N. Y.; "Saving Fuel by the Automatic Regulation of the Damper", by N. C. LOCKE, Salem; "Combustion of Fuel and Boiler Furnaces", by THOMAS MURPHY, Detroit, Mich.; "Rocking Grate Bars", by C. B. HOLLY, Phillipsburg, Pa.

Institution of Civil Engineers:—The Annual Meeting was held on May 29. The main points bearing on the welfare of the Institution were as follows:

A supplemental charter had been obtained extending the power to acquire and hold a hall, messuages, lands, tenements, and hereditaments, from a value of $5,000 per year—as authorized by the original charter—to a sum not exceeding $40,000 in annual value. A copy of this supplemental charter had been sent to every member, together with the biennial issue of the original charter, by-laws, and list of members.

At midsummer last, the freehold of No. 24, Great George Street, embracing the portion of the premises already occupied on lease, was purchased for $75,000. The Institution was now the owner of three contiguous houses, obtained at a cost of $200,000, exclusive of legal and incidental expenses. In accordance with the recommendation of the last Council, openings had been made between the basements, the ground floors and the first floors of Nos. 24 and 25.

The Council had presented a petition against the Westminster (Parliament Street, etc.) Improvements bill, which contemplated taking by compulsion the freehold premises above referred to. The result of this petition was the insertion in the Act—which received the Royal Assent on August 23, 1887—of clauses for the protection of the Institution, the substance of which was as follows: The conveyance to the Institution of the fee-simple in possession of a plot of land on the northern side of Great George Street, having an area of 11,000 sq. ft.; the payment of a sum of $175,000 as full compensation for the buildings, and for all consequential damage; the use of the present premises for eighteen months after possession had been given of the substituted site and the above payment had been made, and, unless within one month after the expiration of twelve months from the passing of the Act a sum of $50,000 should be paid to the Institution as security, the powers of the Act, so far as the Institution was concerned, would lapse. Up to this time, no intimation had been received whether the powers of the Act were to be put in force.

Communications having been received from a committee promoting the registration of architects, engineers, and surveyors, inviting the Council to offer suggestions upon a draft bill to be brought forward this session, that committee was informed that the Council did not intend to take any part in furthering the proposed measure. Later on, however, it became evident that active steps must be taken to oppose the bill, which vitally affected the interests of the Institution, as well as those of the cognate bodies representing architects and surveyors. On behalf of the Institution a statement of reasons against the measure was drawn up, and this formed the basis of a petition to the House of Commons, which was duly presented by Mr. A. GILES, M. P., V. P. Inst. C. E. As the provisions of the bill became better known, opposition increased in various other quarters, and, on the second reading, the opinion of the House was so clearly opposed to the bill that its promoters withdrew it rather than risk a division.

During the twelve months ended March 31, 1888, there had been an addition to the roll of 49 members and of 183 associate members, the number of non-corporate associates being reduced by 23. The increase had been 4.6 per cent. per annum, as compared with 4.19 per cent. for the previous twelve months. The students had increased by 25. At the date named there were on the books 1,617 members, 2,488 associate members, 461 associates, 20 honorary members, and 974 students—together 5,530.

The receipts on account of income during the twelve months under review were $80,357; on account of capital, $21,249; and from trust funds, $2,170. The general expenditure had amounted to $69,780, of which more than one-half was the cost of the publications. A sum of $32,380 had been invested in the purchase of $25,000 London & Northwestern Ry. 4 per cent. debenture

stock, and the outlay on account of trust funds amounted to $2,380. These figures constituted the ordinary receipts and disbursements. Owing, however, to the purchase of No. 24 Great George Street, it had been necessary to sell railway debenture stocks of the nominal value of $45,000, and to transfer from the yearly receipts a sum of $23,085, to meet this outlay. [These amounts are converted at the rate of £1 = $5.—ED.]

The papers read at the ordinary meetings had been of more than usual interest, and had given rise to animated discussions and to much correspondence. Advantage had been taken of the increased accommodation to hold exhibitions of models, appliances, instruments, and specimens in connection with some of the subjects which came under discussion, viz.: "Accidents in Mines", "Manganese Steel", and the "Use of the Plane Table in Topographical Surveying". The success of these exhibitions had formed a most acceptable feature of the Tuesday evening meetings of last session, and it was hoped that they might be repeated and further developed as opportunity occurred.

There had been twelve supplemental meetings for Students, held on Friday evenings, generally at fortnightly intervals. Three of the papers read and discussed had already appeared in the "Proceedings", and five others had been deemed worthy of publication. The Council was glad to notify a distinct advance in the general care and attention devoted to the preparation of these papers, and in the thoughtfulness manifested, as a rule, by those of the students who had taken part in the discussions. In conclusion, the Council had noticed with pleasure the part taken in the discussions at the ordinary meetings during the past session by the younger members of the profession, which promised well for the future reputation of the Institution and of its proceedings.

The adoption of the report was moved, seconded, and carried, and it was ordered to be printed in the Minutes of the Proceedings. Hearty votes of thanks were then passed to the president, to the vice-presidents and other members of the Council, to the auditors, to the secretaries and staff, and to the scrutineers.

The ballot for Council resulted in the election of Sir G. B. BRUCE as president; of Sir JOHN COODE, Mr. G BEEKLEY, Mr. H. HAYTER and Mr. A. GILES, M. P., as vice presidents; and Messrs. W. ANDERSON, B. BAKER, J. W. BARRY, Sir HENRY BESSEMER, F. R. S., E. A. COWPER, Sir JAMES N. DOUGLASS, F. R. S., Sir DOUGLAS FOX, C. HAWKSLEY, J. MANSERGH, W. H. PREECE, F. R. S., Sir ROBT. RAWLINSON, K. C. B., Sir E. J. REED, K. C. B., F. R. S., M. P., W. SHELFORD, F. C. STILEMAN, and Sir WM. THOMSON, F. R. S., as other members of the Council.

The session was then adjourned until the second Tuesday in November, at 8 P. M.

Premiums Awarded, Session 1887-88. For Papers Read and Discussed at the Ordinary Meetings.

1. Telford Medal and premium, ROBERT ABBOTT HADFIELD, Assoc. M., for paper on "Manganese in its Application to Metallurgy", and "Some Newly Discovered Properties of Iron and Manganese".
2. Watt Medal and Telford premium to PETER WILLIAM WILLANS, for paper on "Economy Trials of a Non-Condensing Steam Engine—Simple, Compound and Triple".
3. Telford Medal and premium to EDWARD HOPKINSON, Assoc. M., for paper on "Electrical Tramways: the Bessbrook and Newry Tramway".
4. Watt Medal and Telford premium to EDWARD BAYZAND ELLINGTON, for communication on "The Distribution of Hydraulic Power in London".
5. Telford Medal and premium to JOSIAH PIERCE, Assoc M., for paper on "The Economic Use of the Plane-Table in Topographical Surveying".
6. George Stephenson Medal and Telford premium to Sir BRADFORD LESLIE, for his account of "The Erection of the 'Jubilee' Bridge, Carrying the East Indian Railway across the River Hooghly at Hooghly".
7. Manby premium to the late HAMILTON GOODALL, Assoc. M., for paper on "The Use and Testing of Open-Hearth Steel for Boiler-Making".

For Papers Printed in the Proceedings Without Being Discussed.

1. Watt Medal and Telford premium to Prof. VICTOR AUGUSTE ERNEST DWELSHAUVERS-DERY, for paper on "A New Method of Investigation Applied to the Action of Steam Engine Governors".
2. Telford premium to WM. MANN THOMSON, Assoc. M., for paper on "Improved Systems of Chaining for Land and Engineering Surveys".
3. Telford premium to JAS. WILLIAM WYATT, Assoc. M., for his communication on "Sizing Paper with Rosin".
4. Telford premium to DUGALD DRUMMOND, for paper on "The Heating of Carriages by Exhaust Steam on the Caledonian Railway".

For Papers Read at the Supplemental Meetings of Students.

1. Miller Prize to DAVID SING CAPPER, Stud. Inst. C.E., for paper on "The Speed-Trials of the Latest Addition to 'The Admiral' Class of British War-Vessels".
2. Miller Prize to LAWRENCE GIBBS, Stud. Inst. C. E., for account of "Pumping Machinery in the Fenland and by the Trentside".
3. Miller Prize to HAROLD MEDWAY MARTIN, Wh. Sc., Stud. Inst. C. E., for communication on "Arched Ribs and Voussoir Arches".
4. Miller Prize to JOHN HENRY PARKIN, Stud. Inst. C. E., for paper on "River-Gauging at the Vyrnwy Reservoir".
5. Miller Prize to ALFRED CHATTERTON, Stud. Inst. C. E., for paper on "The Prevention and Extinction of Fires".
6. Miller Prize to JOHN HOLLIDAY, Stud. Inst. C. E., for paper on "Boiler Experiments and Fuel Economy".
7. Miller Prize to ARTHUR WHARTON METCALFE, Stud. Inst. C. E., for paper on "The Classification of Continuous Railway-Brakes".
8. Miller Prize to ROBERT JARRATT MONEY, Stud. Inst. C. E., for his account of "Railway Engineering in British North America."

Engineers' Club of Kansas City, Mo.—A regular meeting was held June 4; T. F. WYNNE in the chair and 14 members and 9 visitors present. The Secretary presented letters from several of the engineering societies with reference to "bridge reform", most of them expressing a desire to co-operate. The following candidates were elected: *Members*; ALBERT N CONNETT, BOLTON W. DECOURCY; Associate Member, VICTOR M. WITNER.

The paper of the evening, "Crossing of the Chicago, Santa Fé & California Ry. over the Missouri Pacific and Chicago & Alton tracks near Rock Creek Station", by Mr. BREITHAUPT, was read and discussed. The bridge is a riveted pony truss, and was interesting on account of the necessity of keeping clear the several tracks over which it crossed on a skew. The discussion was chiefly with reference to the number and spacing of stringers for economy, and the effect of extreme rigidity in bridge superstructures.

At the following meeting of the Society held on June 18, it was decided that members attending the convention of the American Society of Civil Engineers, at Milwaukee, should make known the desire of the club to have the Society hold its next convention at Kansas City.

A letter from Mr. C. L. STROBEL, of the Western Soc. of Engineers, with reference to "Bridge Reform", was read, asking the following questions:

1. Do you favor the appointment of State Engineers?
2. Do you consider it desirable for bridge engineers to adopt a scale of minimum rates for preparing working plans and specifications for bridges?
3. Are you willing to co-operate with this society by the appointment of a committee to consider and report on the subject of a scale of minimum rates?

On motion of Mr. PEARSONS it was voted to get answers to the questions from the club by letter ballot and on motion of Mr. WYNNE it was decided to express a willingness to co-operate in general in the matter, but that definite answers could not be given until reports from our Bridge Reform and Executive Committees was received.

City Engineer DONNELLY then read a paper on "Street Pavements of Kansas City" which was afterward informally discussed. Mr. DONNELLY said that but few streets would ever be devoted to heavy traffic, because the railway system will always carry the bulk of the heavy freight. The first paving of the city was of Telford Macadam, and was put down about 30 years ago. The use of this style continued until 1882, though the increasing traffic rendered the streets rough, unsightly and muddy, and made the expense of maintenance heavy. One section had received annually from 1869 to 1881 one foot in depth of broken rock at a cost of 60 cts. per square yard. In 1881 a section was laid with sandstone from Madeira, N. Y., and practically nothing has been spent on it in repairs, and it gives promise of lasting many years. Cedar block paving was introduced in 1882. At present there are 45 miles of paved streets in the city, equal to one-fifth of the total street mileage; and this is divided as follows:

Telford macadam, 3 miles; Colorado stone on concrete, 1½ miles; Colorado stone on sand, ¼ mile; Medina on sand, ¼ mile; cedar blocks on concrete, 15 miles; cedar blocks on sand and boards, 22 miles; asphalt, 3 miles. The average cost per square yard had been: Macadam, 65 cts., stone on concrete $4, stone on sand $3, cedar blocks on concrete $2.40, cedar blocks on sand and boards $1.50, street asphalt $2.80.

Wood paved streets all last from five to ten years. Cypress costs about 8 cts. per yd. less than cedar. Block pavements with concrete base gave the best results under all circumstances.

Mr. DONNELLY recommended stone blocks for heavy traffic, wood blocks or asphalt for residence streets and where the grade is very heavy, brick, which would be three times as durable as cedar, and would cost no more.

KENNETH ALLEN, *Secretary.*

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Napanee, Tamworth & Quebec.

June 18, 1888.

EDITOR ENGINEERING NEWS:

The locating survey of the Napanee, Tamworth & Quebec Railway has been completed, the plans, profile, and books of reference filed, right of way is now being acquired, and it is the intention of the General Manager to build about ten miles this summer. The work is comparatively light. At Tamworth a deck bridge of two spans of 66 feet each will be built across the Salmon river. The superstructure will be an iron lattice girder; the abutments of masonry. The center pier will be built as follows: 16 in. piles will be driven and capped with a double thickness of 10x12 pine grillage, below water mark. On to is grillage will be placed an oval wrought iron pipe which will be filled with concrete. The concrete will take the whole of the load, the iron being merely for the protection of the concrete from washing and wearing by the stream.

The maximum grade on tangent is 1.5 per cent. and the maximum curve on a level is 6. M.

Toledo, St. Louis & Kansas City.—The track on this road was changed to standard gauge on June 23, from Frankfort, Ind., to Eugene Jc., a distance of 61 miles, making the road standard gauge from Toledo, O., to the Illinois State line, 267 miles. This leaves the portion of the line in Illinois, 184 miles in length, still to be changed to standard gauge.

Detroit, Lansing & Northern.—The last rail has been laid on the Grand Rapids, Lansing & Detroit Railway, extending from Grand Ledge, Mich., to Grand Rapids, a distance of 51 miles. Most of the grading on the line was done last season. The line is to be opened for business at once.

New York, Mahoning & Western.—Suit has been brought against this company by the North Chicago Rolling Mills Company in the courts of Hancock and Putnam counties, Ohio, claiming that the road is insolvent and unable to meet its obligations and praying for the appointment of a receiver.

Pittsburg, Shenango & Lake Erie.—This company has filed a mortgage on its projected line, to the Central Trust Company of New York to secure the issue of fifty year five per cent. bonds to the amount of $2,500,000.

Wheeling & Lake Erie.—A force of graders began work at Bowerston, O., on June 19 on the extension of this road to Wheeling, W. Va. Paige & Carey are the contractors.

Grand Southern Ry. of New Brunswick.—At the foreclosure sale of this road held at Calais on June 19 the road was bid in for the bondholders by RUSSELL SAGE of New York City. It is reported that Mr. SAGE will now interest himself in the construction of the Maine Shore line which has been located from Hancock to a connection with the Grand Southern Ry. at the International boundary.

Northern Central.—This company is reported to be making preliminary surveys for the extension of its Green Spring Branch, in Maryland.

Canadian Pacific.—It is reported that a syndicate among whose members are H. J. BEEMER, and Hon. Mr. Ross of Quebec, are negotiating for the purchase of the Ottawa & Quebec division and if successful will use it as an outlet for the Pontiac Pacific Junction road, now under construction on the upper Ottawa. This in connection with the lines which Mr. BEEMER is completing to the Lake St. John district, would form a railroad system 564 miles in length.

New Projects and Surveys.

Northern Maine.—

MATTAWAMKEAG, Me., June 23, 1888.

EDITOR ENGINEERING NEWS:

I began the preliminary survey of the Northern Maine Railroad, June 6, with a party of fourteen. Expect to run a line and locate from here to Presque Isle, via Patten and Houlton, and also from Bancroft to Houlton, a total of about 150 miles. A second party will probably be put on next month, and perhaps a third later. O. H. TRIPP of Rockland and F. E. HALL are first and second assistants.

FREDERIC DANFORTH, *Chief Engineer.*

Chicago, Dayton & Cincinnati.—Incorporated in Indiana to build a railroad from Huntington to the Ohio State line. The officers are: President, L. P. MILLIGAN; Vice President; L. C. DAVENPORT; Treasurer, HUGH DOUGHERTY; Secretary, THOS. ROCHE; Chief Engineer, GEO. C. PRIDE.

Guelph Junction.—This railway extending from a point one mile west of Campbellville, on the Credit Valley division of the Canadian Pacific, to Guelph, Ont., a distance of 15¼ miles, is just completed. It is to be operated by the Canadian Pacific.

A Confusion of Names.—It is amusing, though sometimes misleading, to notice the frequent errors into which newspaper paragraphers on even the journals of highest standing fall when writing on railway matters. In the New York *Times* of June 28, one paragraph of the financial column refers to "the Vanderbilt interest in the projected West Pennsylvania road," and the next says: "Now the doughty Atlantic and Pacific road has waded into the fight over dressed beef freight rates, and yesterday announced a sharp cut on traffic from Chicago to all New England points."

The question of how the Atlantic & Pacific line through the deserts of the Indian Territory New Mexico and Arizona can compete for traffic between Chicago and New England points is a poser; and the solution of the question by concluding that "Atlantic & Pacific" means Chicago & Atlantic and that "West Pennsylvania" means South Pennsylvania while quite obvious, seems to be asking a good deal from the reader.

Evansville, Ft. Wayne & Chicago.—This company has been incorporated in Indiana, by A. M. DUKE, MILTON SHIRK, and R. A. EDWARDS of Peru. Mr. SHIRK is the owner of the old Wabash & Erie canal bed from Wabash to Lafayette, Ind., and wishes to build a railroad thereon.

Manchester & Portland.—This Connecticut project continues to be agitated. The Glastonbury business men have organized to render it aid and appointed SAMUEL C. HARDIN, HECTOR CHAPMAN and others a railroad committee.

Utica, Adirondack & Saratoga.—The survey of this New York line is in progress under direction of W. A. ROBERTS of Cobleskill, Chief Engineer.

Deer Creek & Susquehanna.—It is reported that Miller & Baldwin have taken the contract to build this road in Harford county, Md., provided $50,000 can be raised in stock subscriptions and right-of-way. JOHNS H. JANNEY, Churchville, Md., can give information.

Lancaster & Safe Harbor.—The Lancaster, Pa., Board of Trade has had surveys and estimates made for a railway from Lancaster to Safe Harbor and finds that the cost would be about $200,000. The Board of Trade has not yet recommended the con truction of the road, but there is some local feeling in favor of the project. ROBT. J. HOUSTON, of Lancaster is Chairman of the Railroad Committee of the Board of Trade.

SOUTHERN

Existing Roads.

Richmond & Danville.—A movement is reported to be on foot to secure terminals for this company at Norfolk, Va. This is to be done by constructing an extension from Raleigh, N. C., to connect with the branch of the Atlantic Coast Line through Rocky Mount and Tarboro. From Tarboro a line will be built to the southern terminus of the Chowan & Southern railroad, on which an option has been secured and which has charter rights for an extension into the city of Norfolk. This is supposed to be a move toward retaliation upon the Seaboard & Roanoke Managers for the extension which they are building to Atlanta, Ga.

Richmond & Alleghany.—Reports are in circulation that this Virginia road is to be absorbed by the Chesapeake & Ohio.

Ohio Valley.—It is announced that the branch to Hopkinsville, Ky., for which that town voted $100,000 a year ago, has been given up. It is announced that the extension to Jackson, Tenn., will be pushed at once and will be built on the direct line surveyed some time ago.

Troy & Tiptonville.—Tracklaying is finished on this road from Rives to Troy, Tenn., a distance of 6 miles.

Chattanooga, Rome & Columbus.—Tracklaying has just been completed on this Georgia road, and the whole line from Chattanooga, Tenn., to Carrollton, Ga., 140 miles, will be opened for traffic early in July. The charter for this company was filed in 1881 and the portion of the line from Rome to Cedartown, 22 miles, was built as a narrow gauge. The movement for the completion of the whole line as a standard gauge was started about a year ago, but the work of obtaining local aid, right of way and funds for construction delayed the commencement of grading till the last of the year. It is thought that work will soon be undertaken on the extension from Carrollton to Columbus, Ga., a distance of about 75 miles.

Columbus Southern.—It is again reported that grading is in active progress on this road, which is an extension of the Georgia, Midland & Gulf road from Columbus to Albany, Ga. The Chattahoochee Brick Co. of Atlanta have the contract.

Louisville & Nashville.—The Nashville, Florence & Sheffield extension is about to be opened for business on July 1. The last spike was driven by MRS. AINSLEY, the wife of the Engineer-in-Charge. The contract for the extension from Pineville, to Cumberland Gap, has been let. There were over 30 bidders for the work. It is rumored that surveys are in progress for an extension through the Sequachee Valley in Tennessee.

Columbus & Western.—The last spike was driven June 19 in Coosa Mountain tunnel on this line, the Birmingham extension of the Central Railroad of Georgia.

Tennessee & Coosa.—About 500 hands are at work on the grading of this Alabama road.

Orlando & Winter Park.—Track is be laid at once on this Florida road which was graded last year.

New Projects and Surveys.

Louisville, Hardinsburg & Southwestern.—This Kentucky project is said to have good prospects of success. An election is soon to be held at Hartford, Ohio county, to consider the question of voting $100,000 aid to the company.

Helena, Batesville & Aberdeen.—A charter has been filed by this company in Mississippi for the construction of a railroad from Aberdeen, Miss., to a point opposite Helena, Ark.

Great Western Air Line.—This is the name of the projected line from Charlotte to Weldon, N. C. Elections for voting local aid are being held along the route.

Richmond & Chesapeake.—At the annual meeting at Richmond, Va., June 27, the following officers were elected: President, C. E. BELVIN of Richmond; Treasurer, H. R. BOLTZER of New York City; Chief Engineer, R. F. O'BRIEN of New York City; Secretary, M. B. PORTLAUX. A contract was entered into with the Richmond Tunnel & Construction Co., E. W. SCOTT, New York City, President, for the building of the railroad and the tunnel at the Richmond terminus.

Osceola Construction Co.—Chartered in Florida for the purpose of constructing railways, by JAS. P. SCOTT, HAMILTON DISSTON and others of Philadelphia.

St. Cloud Sugar Belt.—Incorporated in Florida by ANDREW J. GRAY, J. ETTING and others of Philadelphia, to build a railroad from Kissimmee to Runnymede. It is reported that a contract for building has been let to Douglas & Towne.

Richmond & Seven Pines.—Organized at Richmond, Va., to build a road 8 miles in length. A. G. BABCOCK is President and T. B. MURPHY, Secretary and Treasurer.

Decatur, Chesapeake & New Orleans.—We quoted last week the statement of a sanguine newspaper correspondent in reference to the local managers' trip to New York "to settle minor details." The same correspondent writes under date of June 21, in the following strain:

"Dr. G. C. SANDUSKY, President, W. A. FROST, Secretary, and A. A. MCCORKLE, General Manager of the Decatur, Chesapeake & New Orleans Railroad, have returned from New York very much pleased with their trip and the encouragement with which they met. All the necessary arrangements for the road were completed, and the only thing now needed is the right-of-way. If that is secured, look out for the new road. It all depends on that simple question, can the right-of-way be secured? There seems little doubt about it."

The projectors of the new road are fortunate if the right-of-way is all they need to obtain.

THE NORTHWEST.

Existing Roads.

Fremont, Elkhorn & Missouri Valley.—The general offices of this company have been removed from Missouri Valley, Ia., to Omaha, Neb.

St. Paul & Duluth.—At the recent annual meeting the common stockholders achieved a victory over the holders of preferred stock and elected a new board of directors. R. S. HAYES succeeds W. H. FISHER as President. The latter, however, retains the office of Vice-President and General Superintendent. One of the principal causes of dispute between the new management and the old was the projected extension from St. Paul to Omaha, which had been incorporated by ex-President FISHER and other directors of the company, and on which a considerable amount has already been expended for surveys. The principal holders of the company's securities were unalterably opposed to this scheme, and their success in securing control of the company's affairs puts an end to the prospect that the extension will be built for a long time to come.

Chippewa & Menominee.—This logging road in Chippewa Co., Wis., is being extended 10 miles to Bruce. NEWTON MILLS, of Weyerhauser, Wis., is Superintendent.

Red River Valley.—Tracklaying began on this Manitoba road on June 21 at West Lynne. Rumors have been rife that parties interested in the Northern Pacific are to furnish funds for the extension from Winnipeg to Portage la Prairie which will give the Manitoba & Northwestern an outlet independent of the Canadian Pacific.

Aberdeen, Bismarck & Northwestern.—It is reported that the rails will not be laid on this line to Bismarck, Dak., until next season.

Chicago & Northwestern.—A letter from Hot Springs, Dak., to the St. Paul *Pioneer Press* states that officials of this company have recently visited that region to determine the feasibility of an extension through that point to Custer, Dak.

New Projects and Surveys.

Eau Clair, Mississippi & Lake Superior.—Surveys are in progress on this Wisconsin road under Chief Engineer C. E. BUSSELL between Eau Claire and Independence, Trempeleau county, a division 30 miles in length. A line is next to be run between Eau Claire and Chippewa Falls. The headquarters of the company are at Eau Claire.

THE SOUTHWEST.

Existing Roads.

Fort Worth & Rio Grande.—At the recent meeting of the directors of this company at Fort Worth, Tex., it was voted to begin work at once on the extension to Brownwood. JOHN HORNBY has succeeded O. B. COLTON as General Manager.

Kansas City, Fort Scott & Gulf.—The tracklaying has been completed on the Current River Railroad in southern Missouri, extending from Willow Springs east to Grandin, to which point an extension of the Cape Girardeau Southwestern is being pushed from the East. The whole length of the line is 81 miles, of which 52 miles have been laid since Jan. 1.

St. Louis, Arkansas & Texas.—A report from St. Louis, Mo. says: "Work on the proposed Grand Tower extension of the St. Louis, Arkansas & Texas railway will be commenced in a few days. The question whether the extension would be built at once was favorably decided recently and the funds were forthcoming for the construction of the line. The contract for the greater part of the line—sixty miles, from Malden to Delta—was let last week and the contractor is on his way with a large force to begin construction. The entire length of the proposed line is 87 miles."

Missouri, Kansas & Texas.—The Mercantile Trust Company of New York City has filed an application in the United States Court of the Northern District of Texas for the appointment of a receiver for the lines of this company within that jurisdiction. The stockholders' committee have been making a tour of inspection over the lines of the system.

New Projects and Surveys.

Alexandria & Arcadia.—About 50 miles of the preliminary survey of this line has been completed, from Arcadia, La., north to the Arkansas line. LEON N. POLK of Arcadia is Chief Engineer. Negotiations are in progress with a view to consolidating with other projected enterprises in the same region.

Leavenworth & Denver Short Line.—The preliminary survey is in progress toward Denver and affairs are reported to be "very satisfactory."

Texas Air Line.—Col. WALTER GRESHAM has just been making an examination of this line as located from a point near Houston to Kerens, Navarro Co., Tex., on the St. Louis, Arkansas & Texas, a distance of 175 miles. Engineers are now making preliminary surveys from Kerens, northward. The located line runs through a well timbered country, and the location is said to show light grades and easy curvature.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Utah Central.—

NEVADA, June 15, 1888.

EDITOR ENGINEERING NEWS:

The first preliminary survey of the Utah Central Extension from Milford, Utah, to a point 12 miles west of Barstow, Cal., on the Atlantic & Pacific Ry. was completed on the 8th inst. The company had two parties in the field. One begun at Milford and the other at the west end and each part took a reading with an aneroid barometer on starting. When the levels came together they only lacked $3\frac{5}{8}$ ft. of checking. Another singular incident was that the distance lacked only 9 ft. of being 500 miles.

The elevations varied from sea level, in Death Valley, to 8,000 above. The maximum grade of this route is 2 ft. per hundred; maximum curve, 6°. The work at the western end of this route is comparatively light, while that on the eastern end is more difficult, having considerable rock work and a few high bridges. Two other routes, were surveyed to obtain if possible a shorter line and easier grades. If this road should be built, there will be a big boom in the many small mining camps. R. E. L.

San Francisco, Clear Lake & Humboldt.—The San Francisco *Call* says: "President W. H. H. HART has gone to Chicago. Future proceedings on the Lake County railroad are depending on the result of his trip. If he is successful in arranging things with General McNulta, the road will be built. If McNulta does not care to raise the immense sums of money necessary to complete the undertaking, it will doubtless follow in the wake of the several other Lake County railroad projects which are now dead and forgotten."

Denver & Rio Grande.—General Manager S. V. SMITH is reported as saying that it is probable that some of the lines which have been surveyed to new mining camps will be constructed without much delay. The most important lines are the Rico extension from Dallas and the extension from Sapinero to Lake City, which has already been partially graded.

New Projects and Surveys.

Arizona & Southeastern.—H. P. SELDEN, of Kansas City has the contract for the construction of this road, which is to be built by the Copper Queen Mining Co. from Bisbee to Fairbank, Ariz., about 35 miles.

Yreka Branch.—The second preliminary survey of this branch line from the California & Oregon division of the Southern Pacific is in progress. The distance is about 7 miles.

Columbia & Puget Sound.—A branch is projected from the main line of this Washington Territory road to Kirk's Iron Works.

Seattle, Lake Shore & Eastern.—Grading has begun on the branch to the Raging River coal mines.

Chicago, Rock Island & Pacific.—A press dispatch from Pueblo, Col., states that surveys are in progress for an extension from Dodge City, Kan., to Pueblo. The account of the Rock Island's financial condition, published elsewhere in this issue, tends to cast a shadow of doubt on this statement.

Southern Pacific.—The San Joaquin division will be opened for traffic on July 1 from Tracy to Newman, 37 miles. The completion of the Santa Rosa & Carquinez line was celebrated at Santa Rosa by a barbecu and ball.

Contracting.

The Cairo Bridge.—The caisson of the second pier from the Kentucky side is down within 6 ft. of its resting place and work is progressing rapidly.

The National Ballast and Paving Material Co., of Chicago, has been incorporated to make and sell a material for ballast and paving produced from burnt clay. Capital, $100,000. Incorporators, DELOS O. COLE, CHARLES A. SMITH and JOSEPH GERSTLEY.

Water-Works.—*Malone, N. Y.*—The Malone Water-Works Co. has awarded the contract for material and construction to Edgerton Bynner, of New York. There will be a receiving basin, 20 × 30 ft.; a reservoir 200 ft. square; 1,828 ft. of 6-in. cast-iron pipe, 35,870 ft. of 10-in. and 7,000 ft. of 12-in. Also the trenching and back filling, all necessary specials, gates, valves, etc., required to complete the work according to the plans and specificatoins of D. M. GREENE, C. E.

Coburg, Ont.—Moffett, Hodgkins & Clarke, of Watertown, N. Y., have a contract for a system of water-works at Coburg. There will be 6 miles of pipe, 68 Ludlow hydrants, a steel tower, 104 ft. high, and 2 Worthington pumps with a daily capacity of 1,500,000 galls. The works are to be completed by July 1.

Sewerage System.—The following proposals were received June 14, by H. J. REID, City Engineer, Colorado Springs, Col. The contract was awarded to McShane, Clough & Moore, who will commence work about July 5. Akron pipe will be used. The city will build the 17 flushers and will furnish the manhole covers. An informal bid was also made by the Bullen Bridge Co.

Bidders.	6 in pipe 26,065 ft.	8-in. pipe 9,703 ft.	10-in. pipe 2,083 ft.	12-in. pipe 3,904 ft.	10-in. × 6 in. Y's 50	8 in. × 6-in. Y's 1,200	1 pipe manhole 62	1 branch manhole 14	2 branch manhole, 4	Wrought-iron 1,040 lbs.	Concrete 1 yd.	L'mb'r 1 ft. B.M.	Ded. per ft. dep. less than 8 ft.	Add per ft. dep. gr'ter than 11 ft.	Total amount of Bids.
	$	$	$	$	$	$	$	$	$	$	$	$	cts.	cts.	$
J. W. Sullivan, Denver, Col.	1.08	0.98	0.94	0.90	0.70	0.50	36.00	36.00	——	0.08	4.00	0.027	10	25	46,733.23
Joseph Williams, Denver, Col.	0.90	0.97	0.92	0.97	0.70	0.50	33.00	35.00	45.00	0.06	4.00	0.025	3	10	44,597.57
J. F. Hughes, Ft. Worth, Tex.	0.97	0.82	0.93	1.02	1.00	0.75	30.00	40.00	45.00	0.08	6.00	0.0215	15	30	42,798.00
J. H. Haney, Little Rock, Ark.	0.93	0.71	0.89	1.10	0.10	0.08	42.00	42.50	43.00	0.10	4.00	0.022	22	26	40,857.87
Paradice & Ratican, Denver, Col.	0.96	0.81	0.82	0.80	0.80	0.50	24.60	26.00	30.00	0.06	5.40	0.018	15	20	40,430.10
W. C. Bradbury, Col. Spr	0.94	0.74	0.89	1.10	0.57	0.34	23.75	24.00	——	——	9.00	0.03	10	20	40,279.62
George Stone, C. l. Spr	1.02	0.59	0.66	0.71	0.60	0.49	20.00	20.00	20.00	0.07	6.00	0.02	43	19	38,754.51
J. O'Connor & Co., Dallas, Tex.	0.85	0.78	0.98	1.13	0.32	0.24	21.00	23.00	25.00	0.125	4.50	0.0325	7	12	38,338.98
Everson & Liddell, Lockport, N. Y.	0.87	0.67	0.77	0.85	1.25	0.84	30.00	35.00	40.00	0.25	6.00	0.02	20	30	37,946.39
Howard A. Williams	0.80	0.77	0.92	0.97	0.80	0.60	25.00	30.00	35.00	——	7.00	0.035	3	20	37,003.90
J. H. Bennett & Co., Pueblo, Col.	0.69	0.67	0.75	0.88	0.75	0.50	27.00	27.00	27.00	0.06	——	0.025	2	4	32,343.53
John J. Everson, Akron, O.	0.70	0.60	0.70	0.82	0.75	0.60	19.00	20.00	21.00	0.10	8.00	0.04	10	30	31,138.22
McShane, Clough & Moore, Col. Spr.	0.67	0.60	0.71	0.77	0.99	0.95	25.60	27.50	30.00	0.06	1.00	0.018	——	55	31,078.27
D. Mitchell, Pueblo, Col.	0.63	0.53	0.70	0.79	0.65	0.45	24.00	26.00	28.00	0.05	8.00	0.015	10	15	28,702.21
F. Nicholson & Co., Pueblo, Col.	0.42	0.52	0.50	0.50	0.85	0.40	10.00	10.00	10.00	0.10	1.90	0.021	——	——	19,429.48

Railway Contracts.—*Lynchburg & Durham.*—Jesse E. Adams & Co., of Amherst, Va., have been awarded the contract for tracklaying from Lynchburg to Rustburg.

Cape Fear & Yadkin Valley.—W. P. Fortune, of Monroe, N. C., has been awarded a contract for grading 30 miles of the extension from Fayetteville to Wilmington.

Georgia Pacific.—Gibson & Copening, of West Point, Miss., who have a contract for 9 miles of the Mississippi extension, have sublet 7 miles to M. Little and 2 miles to L. L. Crump.

Cross-Ties.—The contract for 120,000 cross-ties for the Mississippi extension of the Georgia Pacific road, has been awarded to Julian Bros., of Vicksburg, Miss.

Artesian Well.—At Galveston, Tex., J. W. Byrnes has taken a contract to put down another well for the Texas Ice & Cold Storage Co.

Dredging.—The Harbor Board, of Baltimore, Md., have received the following proposals: Canton Dredging Co., 14¼ cts. per cu. yd. in channel and harbor, 19¼ cts. in Black basin and docks, 15¼ cts. in Spring gardens; Samuel P. Wilson, 14½ c.s., 20 cts., 16 cts.; T. J. Fobes, 14 cts., 15 cts., 19 cts.; Baltimore Dredging Co., 15 cts., 19½ cts., 16 cts.; C. W. Nelson, Jr., 14.3 cts, 16 cts., 15.7 cts.

Court House Plans.—At Denver, Col., the County Commissioners have awarded the $300 premium to F. E. Eberly, and the $200 premium to R. S. Roeschlaub. The estimated cost of the work, according to the plans, is $379,000 and $238,000 respectively.

Street Work.—The following are the prices of the engineer's estimate for work at Lincoln, Neb.: Sioux Falls granite on sand, on broken stone and sand, and on concrete, $2.75, $3.17 and $3.35 per sq. yd., complete. Colorado sandstone, $2.70, $3.12 and $3.30 on similar foundations. Excavation for excess grading, 40 cts. Concrete in place, $6.50 per cu. yd.; sand, $1.50 per cu. yd.; broken stone, $3.25 per cu. yd. Colorado stone stub curbing, 60 and 55 cts. per lin. ft. for 15-in. x 5-in., and 15-in. x 4-in. O. N. GARDNER is City Engineer.

Concrete Sidewalks.—The following is the contract description of tar concrete sidewalks at Providence, R. I. All material above grade shall be excavated and removed. Good sand or gravel shall be used for filling whenever it may be required. The foundation shall be composed of clear coarse gravel, properly coated with tar, and shall not be less than 2 ins. in depth, after being rolled and thoroughly compacted. The top of the foundation shall be brought to smooth surface by the addition of fine pebbles completely coated with tar, and thoroughly rolled. The top dressing shall consist of clean, sharp sand, thoroughly saturated with tar, and applied in a layer of such thickness that, after being rolled and compacted, it will not be less than an inch in depth. The total depth of walk when finished shall not be less than 3 ins. The quality of the tar used shall be equal in all respects to that made by the Providence Gas Co. The gravel and sand shall be thoroughly dry before coating and saturating the same with tar. They have a rise of ⅜-in. per foot from the inside of the curb to the street line.

Railroad and Bridge.—Jones & Stanstill, of Knoxville, Tenn., have the contract for two miles of railroad, including a tunnel, for the Powell's Valley R.R. They have also the contract for the masonry of the Clinch River bridge.

Street Railway.—At Denver, Col., the Berkeley Park Rapid Transit Co. has let the contract for grading to Alexander De Lappe, and for 150,000 ft. of cross ties to Hallack & Howard.

The Underground Cable & Conduit Co. is to be organized by Robert R. Zell, of Baltimore, Md., and others. Capital stock, $150,000.

Public Building.—The following proposals for the superstructure and completion of the post-office at Springfield, O., have been recorded by W. A. FREERET, Supervising Architect, Treasury Dept., Washington D. C.:

McCarthy & Baldwin, Washington, Ludlow Falls stone, $87,358; Dayton limestone, $81,599; Bedford (O.) stone, $80,599; Berea stone, $77,500; buff sandstone, $80,-358; Indiana lime stone, $82,$55——G. W. Corbett, Washington; Ohio blue stone, $77,700, according to specifications, $78,500.——Robert Thomas, Cincinnati freestone, $86,916; Bedford limestone, $89,916.——E. F. Gabel, Chicago, Ohio bluestone, $84,167; according to specifications, $84,967.——Mindhan & Funk, Berea stone, $71,260; according to specifications, $72,760.——John Ronzer & Co., Dayton limestone, $81,890; Bedford limestone, $80,-390; Berea limestone $77,890, buff sandstone, $79,690.——Rice & Bassett, Indiana limestone, $91,422; Ohio blue stone, $90,600.——Thomas & Driscoll, $86,500.——Theodore Brockmann, Fremont, O., Bedford (Ind.) buff stone, $66,595; Amherst buff stone, $65,595.

Electric Railway.—At Manchester, Va., the Manchester Railway & Improvement Co, will build an electric railway.

Dam.—Driscoll & Gochnaer have the contract for the construction of the stone dam for the new paper mill at Appleton, Wis. The contract price is $25,000.

Bulkheads.—At Baltimore, Md., the Harbor Board has awarded the contract for bulkheads in the city dock to Ross & Sanford, of Jersey City, N. J., the only bidders. The bids were class 1, excavation, grading and paving per 100 ft., $4; class 2, yellow pine piles, driven and cutoff, $3.50; class 3, oak piles, $6.50; class 4, for all timber in place, per M feet, board measure, $25; class 5, for all iron, per pound, 3¾ cts.; class 6, all masonry, per cubic yard, $6; class 7, coping in place, per lineal foot, $2.50.

New Croton Aqueduct.—At the meeting of the Aqueduct Commissioners, on June 14, all the bids for deepening and finishing shaft No. 24 were rejected. New proposals will be received until July 3.

The Boston Rotary Pump Works has furnished a 4-in rotary pump to Mr. Cramm, contractor for the Stony Brook sewer at Boston.

The Mt. Waldo Granite Co., of Frankfort, Me., was the lowest bidder for cut granite for the new Congressional library building at Washington. Their bid was $33,919.

Pumping Engine and Boilers.—The following proposals for a pumping engine of 2,000,000 gals. daily capacity, were opened by the Water Commissioners, Buffalo, N. Y., June 23: Holly Manufacturing Co., Lockport, N. Y. $88,250, $82,750, $62,750 the latter being for a triple expansion engine. The following proposals for boilers were also received and the contract awarded to M. Riter:

Farrar & Treffts, four cylinder boilers	$5,095.57
Farrar & Treffts, marine boiler	2,921.20
Lake Erie Boiler Works, four cylinder boilers	5,000.00
Lake Erie Boiler Works, marine boiler	2,600.00
M. Riter, four cylinder boilers	4,137.00
M. Riter, marine boiler	1,925.00

Pumping Engine.—The Aqueduct Board, Newark, N. J., has awarded the contract for a pumping engine of 5,000,000 galls. daily capacity, to Henry R. Worthington, of New York, at $17,970 for a low duty engine. The list of bids was given on p. 502, and all were for high duty engines, with the exception of that of H. R. Worthington. In the list of bidders we omitted the address of the National Iron Works and Archibald Young, which are at New Brunswick, N. J., and Toronto, Canada, respectively.

Cable Railway.—At Denver, Col., the Denver Tramway Co. has let the contract for the excavation of the cable line, 6¾ miles of double track, to J. S. King & Co. The Colorado Iron Works will supply 12,000 cast-iron yokes, weighing 260 lbs. each. The cable cars will be built by Weber Bros., of Denver. The road is now under construction and three concrete mixers are at work mixing the concrete and dumping it into the trench. The wire cable will be 1¼ in. in diameter, and will be made by J. A. Roebling Sons' Co., of Trenton, N. J. The Consulting Engineer is H. M. LANE, of Cincinnati. The machinery will be supplied by R. Wetherell, of Chester, Pa.

Pumping Engine.—At Portland, Ore., the Portland Water Co. has let the contract for a steam pump to the Holly Mfg. Co., of Lockport, N. Y., at $7,400.

Levees.—Col. S. W. HOLMES has contracts for levee work in Madison and East Carroll parishes, in Louisiana.

Bridge Masonry.—A. V. Gude, of Atlanta, Ga., has the contract for masonry and substructure for the Yazoo River bridge on the Georgia Pacific R. R.

Snow Sheds.—A number of contracts have been awarded by the Canadian Pacific Ry. Co. for building snow sheds on the eastern slope of the Selkirk mountains. Messrs. MacLean & Whitehead, of Winnipeg, have secured the eastern, and the western slope has been awarded to D. B. Campbell, of Strathroy, Ont.

Macadam Roads.—The Committee appointed by the town of South Kingstown, R. I., to build 2 miles of macadam road in that town opened the following bids on June 6. J. P. Cotton, of Newport, R. I., $19,108; Isaac R. Robinson, of Wakefield, R. I. $18,427.20; C. W. Blakeslee & Son, of New Haven, Conn., $15,074.40; Wm. C. Caswell, of Wakefield, R. I., $11,000. The contract was awarded to W. C. Caswell. The road consists of 3 layers of crushed stone; the first 4 ins. to be of 1-in. to 2½-in. stone, the next 3-ins. to be of 1-in. stone and coarse screenings which will not pass through a screen of 2 spaces to the inch; the third layer to be of coarse and fine screenings. The contractor is to bring the road to grade, doing all necessary excavation and filling. The work is in two sections of 1 mile each; 1½ mile being 20 ft. wide and the remainder 16 ft. wide. The work is to be completed in 6 months. B. E. NELME of Kingston, R. I., is Town Clerk.

Proposals Open.

Dredging.—Hudson river improvements. Bids on the work at Bath Shoal, Kellogg Shoal, Fish House Shoal, Washington Bar and Van Buren Bar were rejected, and the work readvertised. JAMES SHANAHAN, Albany.

Sewerage.—Village Trustees. Barree, Vt.

Shore Protection.—Length required 6,000 ft. Available funds $53,000. F. A. MAHAN, Capt. Eng, Erie, Pa. July 2.

Street Work.—Grading, curbing and macadamizing, and paving with brick and granite. WILLIAM STEYH, City Eng. Burlington, Ia. July 2.

Building.—"Department of Public Comfort" for West Park. JAMES BROWN, Comptroller, Allegheny, Pa. July 3.

Sewers.—Approximate requirements, Bergen street, 400 ft. 18-in. salt glazed pipe, 660 ft. 12-in. sewer pipe, 630 ft. 10-in. sewer pipe, 7 basins, 7 manholes. State Street 70 ft. 15-in. sewer pipe, 560 ft. 10-in. sewer pipe, 4 manholes, 2 basins, granite heads. Mount Pleasant Ave., 600 ft. 10-in. pipe, 3 manholes, one flushing tank. JOHN HUNKELE, Street Com., Newark, N. J. July 3.

Water-Works.—Extensions of present system, the supply being taken from Cleveland water-works. Address H. M. FARNSWORTH, Room 10, 219 Superior St., Cleveland, O., July 3.

Aqueduct.—Deepening and widening Shaft No. 24 Section A, and constructing a head house. JAS. C. SPENCER, Pres. Aqueduct Com. 280 Broadway, N. Y. July 3.

Bridge.—Iron bridge with stone substructure. P. V. TROVINGER, County Clerk, Junction City, Kan. July 5.

Building.—Public Library. Address HUGH O'BRIAN, Mayor, Boston, Mass. July 5.

Water-Works.—Two large wells. PERCY M. BLAKE, Eng., Dover, N. H. July 6.

Water-Works.—A water tower to hold 50,000 galls., brick engine house, supply well and 1¼ miles of water mains of 8, 6 and 4-in. pipe. C. F. ELLIS, Pres. Trustees. Ligonier, Ind. July 6.

Sewers.—Iron castings for manholes, 15,000 lbs., cement 3,500 bbls. Sewer brick, 1,700,000. W. H. PHILLIPS, Clerk of Board Pub. Works. West Bay City, Mich. July 7.

Sewer.—Timber and plank outlet sewer, 450 ft. Brick and masonry sewer, 850 ft. Concrete and masonry sewer, 7,500 ft. Cast-iron pipe sewer, 100 ft. Vitrified stone pipe sewer, 1,497 ft. WILLIAM C. WORTHEN, Eng., 63 Bleecker St., N. Y. DAVID C. CURTIS, Chairman Water-Works Com., Mount Vernon, Westchester Co., N. Y. July 9.

WATER.

Belize, British Honduras.—A water company is about to be organized to operate under a franchise granted by the city. The population is about 6,000.

Lincoln, Neb.—Some trouble has been experienced with the quality of water from the driven wells. Samples from each well are being taken and analysed.

Brunswick, Ga.—At a recent meeting of the Brunswick Light and Water Co, held in Macon, the following board of directors was elected: W. A. JETER, W. E. BURBAGE and H. T. KEENAN, of Brunswick; E. C. GRANNISS and A. E. BOARDMAN, of Macon. The officers are: W. E. BURBAGE President; A. E. BOARDMAN, Treasurer and Superindent; J. B. HALL, Secretary.

Wheeling, W. Va.—A new natural gas company, composed entirely of Philadelphia capitalists, has been chartered in this State to supply the manufacturers of this city. Application has been made to Council for permission to pipe the streets. The company has several thousand acres of gas territory near Amity, Pa.

Albany, N. Y.—The work at West Albany for the city's new water supply will be completed within the contract time. President VAN DER VEER, of the Special Water Commission, is of the opinion from present indications that the prescribed quantity (15,000,000 galls. per day) and quality of water at the driven well plant, will be obtained August 1. Other members of the commission hope to begin the test July 1.

Lamar, Col.—The Colorado Canal & Reservoir Co. has pushed work rapidly. Its ditch is now complete and full from a point east of Las Animas nearly to the State line, and work is still going on. The city now receives its irrigation from this ditch, every block in the city being brought under its moisture. This ditch has been of great benefit to the valley of the Arkansas, bringing several hundred thousand acres under water at this place. It is about 20 ft. wide and 4 ft. deep. It is two miles south of, and 86 ft. above, the Arkansas river.

Chicago, Ill.—According to local reports the new lake tunnel for the water-works is giving considerable trouble to the builders, owing to the amount of quicksand which has to be dealt with. It not only interferes with the work, but by its constant slipping is causing a settlement of the surface of the ground. This trouble is experienced at both of the two tunnels which run inland from the shaft at the lake front, the lake tunnel itself not having been started. The contractor, Mr. ONDERDONK, has now dug four shafts; one at Desplaines, which has been worked east for 800 ft.; one at 5th Ave., which has been worked west 150 ft. and east 450 ft.; one at the lake front, (foot of Peck Court,) which has been worked 536 ft. west and 506 ft. south, and the last is now being dug at the south end of the Lake Front park (foot of Hubbard Court). This latter is where the tunnel will start for the lake.

Sault Ste. Marie Mich.—The Water Power Co. has made a satisfactory agreement with the city. The people subscribe $100,000, of which $50,000 is to be cash in the bank July 15, and $50,000 on demand Oct. 11. In return they get 2,000 shares of stock at 50 cts. on the dollar. The company is to put up in city banks $100,000: one-half cash and the other good securities, maturing Oct. 15, all of which is to be expended in building the proposed water power canal through the city. Work is to begin in 30 days after the first deposit. The canal is to be constructed as soon as possible, and the city must build and maintain all needed bridges. All parties wanting power are to have access thereto at reasonable rates up to certain limitations, and free mill sites are to be given manufacturers. The power thus secured is practically unlimited, and the prospects for making the town the seat of extensive manufactories are greatly strengthened by the action now taken.

Brooklyn, N. Y.—The Brooklyn Electric Light & Power Co. made application Aug. 1, 1887, to the Board of Aldermen for permission to open a portion of streets located in a certain described district of the city, for the purpose of placing under the surface of said streets a separate, independent conduit, adapted to the carrying of the wires of a system of incandescent electric lighting, the conduits to be placed in position and operated at the expense of the company. Pending consideration of this application the company makes application for permission to open a portion of Kent Ave. from Grand Street to Broadway (which is included in the district over which the company desires to operate) for the purpose of demonstrating the feasibility of the methods described, which method has been approved by the Board of Commissioners of Electrical Subway of the City of Brooklyn by a resolution passed at a meeting of said Board held July 12, 1887. In case of failure to prove that electric light wires can be laid and successfully operated under ground by the method described, the company will agree to take up its conduit and place the portion of the street occupied in as good condition as before using the same, and will furnish assurances of its ability to carry out all of its agreements, and to the City of Brooklyn satisfactory security against all damages, should any be incurred. The names of the gentlemen composing the Board of Trustees are ANDREW B. BAIRD, President; FRANKLYN COLT, GEO. RICARD CONNER, BERNARD PETERS, JOHN T. RUNCLE, RICHARD G. PHELPS, LEWIS R. STEGMAN, NOAH L. COCHEU, all of Brooklyn, and THOMAS BLACK, of New York, representing the Looms Electric Manufacturing Company of Boston, Mass.

San Francisco, Cal.—The Spring Valley Water Co. has made an appeal to the public to be careful in the use of water for domestic purposes, as the supply will not admit of careless use or waste. There is an ample supply for legitimate use, but if much waste takes place the supply is likely to run short before the new works are completed. The company, therefore, requests citizens not to use hose for washing steps or sidewalks or sprinkling streets.

The Jenney Electric System.—An important decision has been filed in the Federal court at Indianapolis, Ind., in the case of CHARLES F. BRUSH, of Cleveland, against JOHN OWEN, and others, in which an infringement of patent was alleged by complainants, testing the validity of what is known as the Jenney system. The opinion, by Judge Gresham, is as follows:

1. The invention shown in the patent sued on was declared in patents 212,183 and 218,208, but in 212,183 the examiner held that BRUSH'S claims were too broad. That decision was acquiesced in, and the invention which was there described, claimed, and rejected is now claimed in the patent sued on. The rejected invention was dedicated to the public by acquiescence in the ruling of the examiner, and cannot be claimed in a subsequent patent against others who meantime entered the field and used the rejected invention.
2. The patent in suit is limited to solenoids, and it does not include the common or electro-magnet, and thus construed the patent sued on is not infringed by the defendants.

These briefly are the reasons for dismissing the bill for want of equity. The decision is regarded as unusually important, and the case is expected to go to the Supreme Court of the United States.

Water-Works.—*Maine.*—Ellsworth. A lively mass meeting was held and a resolution to instruct the Mayor and Aldermen to make a contract with some company for a system of water-works was defeated.——Saco. The water-works company here are about to add 70 hydrants to the system.——Houlton. The Houlton Land Company are expecting to build water-works here.——Caribou. The Caribou Water Power Company has been formed with a capital stock of $60,000, for the purpose of establishing a first class water-works system, with a capacity of 1,000,000 galls. per day. The reservoir is to be 180 ft. above the village. The company offer to supply 25 hydrants for fire protection for $2,000 F. H. CLERGUE, Bangor, is President, and Hon. HERBERT M. HEATH, Augusta, is Treasurer.

Massachusetts.—Chicopee. Contractor LYNCH has commenced laying the Front Street water main.——Milford. The Selectmen have made a contract for a water-works system for fire and other uses, to be completed by December 1.

Rhode Island.—Woonsocket. Commissioner ELLIS has pointed out the pressing need of an additional storage tank to cost about $10,000, as a safeguard against fire.

New York.—Sandy Hill. Active steps are being taken to form a company for the purpose of equipping this town with water-works. The capital stock of the company will be $60,000. An application for the privilege of taking water from certain streams and wells has already been granted.——Buffalo. An addition is to be made to the boiler house at the pumping station, and a retaining wall and chimney built.——Sing Sing. The Water Commission, after about a year of negotiating with New York, ineffectually, to tap the old aqueduct, which runs through the village, have now decided to take their supply from Indian Brook and advertise for proposals to lay the pipes.

Pennsylvania.—Pittsburg. Four wells on the beach below the town have just been completed and from these the summer supply of water will be taken. The wells are 40 ft. deep. The water is cool and pleasant and chemically pure. The pumping plant for forcing the water to the reservoir, a mile and a half away, has a daily capacity of 5,000 barrels. The cost of this addition to the water-works has been about $3,000.

Ohio.—Cambridge. It was decided by a majority of 595 to have water-works here, and the town will be bonded for that purpose.

Illinois.—South Evanston. The new water-works were opened June 16.——Peoria. The water-works company have commenced laying the mains.

Alabama.—Jacksonville. The Jacksonville Mining & Manufacturing Co. will enlarge the water-works.——Oxford. Water-works are contemplated, but as yet nothing definite has been done.——Tuscumbia. The city council contemplate securing authority, at the next session of the Legislature, to issue bonds to build water-works.

Arkansas.—Pine Bluff. The water-works will be completed by a new company composed of Mr. THOMPSON, of St. Louis, Mo., and others.

Missouri.—Washington. A special election held to decide whether the town should have water-works, resulted in an overwhelming majority in favor of them.

Minnesota.—Mankato. Plans for a $2,500 pump house for the water-works have been adopted.

Colorado.—Pueblo. Work on the Teller ditch will be soon begun. It will be 30 miles long, and will irrigate 200,000 acres of land.

California.—Alameda. The lack of water is at an end, an abundant supply coming from the fifteen new wells at Fitchburg.——Redding. A scheme is being pushed to form an irrigation district under the Wright bill, the water to be taken from the Sacramento river.

Montana.—Miles City. A system of water-works will be constructed here.

Electric Lighting.—*Rome, N. Y.*—The Common Council opened two proposals for electric lighting on June 25. The Mohawk Valley Co. bid 34¼ cts. per light per night for 5 years. The Rome Gas Light Co. bid 36 cts. and 33 cts. per light per night for 3 and 5 years respectively. A contract will be made with the latter company.

Lexington, Mo.—E. W. ABENDROTH, President of the Lexington Water Company, has applied for a franchise to erect and operate a system of electric lighting in connection with the water-works. He will shortly be in the market for the purchase of a small arc plant.

The Electric Light in Brooklyn, N. Y.—The daily press is raising a stir over the high price paid for the electric light. There are 1,007 lamps, for each of which the city pays $182.50 per annum, or $183,777.50; while it is calculated that $67.50 per annum would give a profit of 30 per cent. The *Eagle* states that at Toledo, O., the price is $36; at Lewiston, Me., $46; and at London, Ont., $92. The trouble seems to be that the politicians are financially interested and prospective competing companies are not allowed a chance.

Albany, Ga.—A vote will be taken shortly on the proposition to issue bonds for $55,000 for a system of water-works, and $10,000 for an electric light plant.

Sewers.—*Northampton, Mass.*—The sewer question is again being agitated. The matter has been discussed and delayed several times since 1880, and in 1882 a committee investigated the matter; a majority report was made in favor of the "separate" system, and a minority report in favor of the "combined" system.

Ware, Mass.—It is proposed to issue bonds to raise money for establishing a sewerage system.

New Rochelle, N. J.—A new Board of Sewer Trustees has been elected and the Board will begin work at once on the preparations for establishing a sewerage system at a cost of $300,000. Construction will commence in the fall.

Reading, Pa.—The Committee on Sewers has agreed to have a plan for a comprehensive sewerage system for the entire city prepared by a sanitary engineer. It is estimated that the complete system will cost from $280,000 to $500,000.

Asheville, N. C.—The city voted July 10 on the proposition to issue $100,000 for a system of sewers.

Bessemer, Ala.—The Bessemer Land & Improvement Co. will extend its sewerage system. Pipe has been purchased.

Fresno, Cal.—A report on the proposed system of sewerage has been made by Engineer KING.

San Luis Obispo, Cal.—A "separate" system of sewerage is to be put in by Col. GEO. E. WARING, Sanitary Engineer.

Los Angeles, Cal.—The Board of Trustees has prepared an ordinance providing for the issue of $1,000,000 in bonds for a sewerage system.

Olean, N. Y.—The Board of Trustees has decided to build a trunk sewer from the old canal basin to the river; also an iron bridge on Union St., and several more electric lights will also be placed in various parts of the town.

Fort Collins, Col.—The City Council has instructed the Committee on Public Grounds to proceed at once to the construction of a drain up Mountain Ave., through the center of the city, to carry away the surface water in the west part of town. Chairman Arthur, of the committee, will probably superintend the work.

Natural Gas at Sea Isle City, N.J.—The West Jersey R. R. Co. struck a flow of natural gas recently when drilling an artesian well.

The Electric Light & Motor Mfg. Co. has been incorporated at Chico, Cal., by JAS. ANTHONY, A. MCFAYDEN, W. H. SCHOOLER and B. F. CLARKE. Capital stock, $100,000.

The Austin Bluff Land & Water Co., of El Paso Co. Col., has been incorporated at Colorado Springs, Col., by FREDERICK L. MARTIN, ALVIN A. MCGOWNEY, MATTHEW KENNEDY, T. G. WATERMAN, HARRY S. WOODRUFF and WM. OTIS. Capital stock, $250,000. The company will lay out a town site near the city and construct and maintain ditches, reservoirs, lakes, etc.

The Delaware Water Co., has been organized by Philadelphia and Pittsburg capitalists; the object being to supply the towns of Greensburg, Jeanet, Irwin, Penn and Grapeville with water for domestic and manufacturing purposes. The water supply will be obtained from a number of small streams in Chestnut Ridge 8 miles east of Greensburg. Sub-lines will be laid from each of these streams to two larger mains. The contract for laying the pipe to Greensburg has already been awarded to Stark Bros., of that place. The estimated cost of the entire plant is $400,000. The large glass factories at Grapeville and all the water stations of the Pennsylvania Railroad will be supplied by this company.

El Paso, Tex.—El Paso's present excitement is the water-works question. A company has constructed two reservoirs on a high mesa overlooking the city, into which the water is lifted by a steam pump from the Rio Grande and then distributed from the reservoirs through the city. The citizens have always complained about the quality of the water furnished. It is never clear and very often too muddy for use. The company owning the water-works has so far failed to furnish settling reservoirs, and great indignation exists among the water consumers in regard to the matter. For weeks past the sessions of the City Council have been devoted to debates as to how the city could compel the company to furnish better water, and the matter has been aggravated by the company having been detected a few days ago in pumping from the Acequia, which furnishes El Paso with irrigating facilities, instead of from the river itself. This seemed to account for the numerous complaints recently made by the citizens that the Acequia did not furnish water enough for irrigation. The water-works pump had taken nearly all of it out before it could reach the city. The Superintendent of the Water-Works, Mr. WATTS, has been arrested and fined in the Mayor's Court, and the City Council thinks of instructing the City Attorney to enter suit against the company for the payment of regular rates such as are paid by the citizens for Acequia water, which at the rate of 50 cts. for 1,000 galls. would amount for two years to over $35,000. At a meeting of the City Council it will be decided what steps shall be taken in the matter. The Southern Pacific Railroad Co. has heretofore taken all the water needed in El Paso from the water company, about 100,000 galls. per day; but it has built and is commencing now to use its own water-works, situated near Fort Bliss where two reservoirs, holding 100,000 galls., lead the water through a 4-in. pipe direct into the Southern Pacific depot. The fall is 95 ft. and gives a good fire pressure.—St. Louis, Mo., *Globe Democrat*.

Red Bluff, Cal.—A proposition has been made for the city to subscribe $250,000 for bringing water from the Sacramento river for manufacturing purposes.

Newport, R. I.—The City Council has voted to renew its contracts for street lighting with the present contractors at a uniform reduction of 10 per cent. from present prices. The contracts include electric, gas and naphtha lamps, and the new contracts, which are satisfactory to the contractors, will save the city several thousand dollars. The contractors are the Thomson-Houston Electric Light Co., the Globe Light Co., of Boston, and the Newport Gas Light Co.

Sewage Disposal.—At Manchester, Birmingham, and other towns in England, where "dry" closets are used extensive works are constructed for completely drying the night soil. The "concentrator" is thus described by Mr. WILEY, superintendent of the Manchester works, in a paper read before the Manchester Scientific & Mechanical Society: "The apparatus consists of a jacketed cylinder fixed horizontally, with a hollow spindle running through its center, to which are affixed a number of hollow arms, both spindle and arms being heated with steam. When the spindle is put into motion, the heated arms come in contact with the material with which the machine has been filled and dash it against the heated surface of the cylinder. This disintegrates the material and deprives it of its moisture by evaporation, while a fan connected with the machine draws out the vapor as rapidly as it is generated." This machine will in 24 hours concentrate about 40 tons of material, as it is received, into about 15 tons of dry fertilizer, which is in great demand by the farmers and is sold as fast as it is made.

Annual Reports.

Turner's Falls, Mass.—The Board of Water Commissioners have presented their second annual report, being for the year ending May 2, 1888. The works were designed by and built under the supervision of PERCY M. BLAKE, C. E. of Hyde Park, Mass., whose report dated April 23, accompanies that of the Commissioners. The high water level of the reservoir is 452 ft. above sea level. Water is taken from Lake Pleasant, at a point about 170 ft. from the shore and at a depth of about 20 ft. through a 14-in. suction pipe protected at the outer end by a crib. The water is pumped to an earth reservoir, with a capacity of 1,270,000 galls.; it is 110 ft. diameter at the bottom, 164 ft. at the top; 18 ft. deep with 13 ft. of water; the slopes are 1½ : 1 and the bottom is covered with a 6-in. concrete floor, while the inner slopes are paved with granite blocks. There is a compound, condensing duplex pumping engine, furnished by the Deane Steam Pump Co., of Holyoke, Mass.; diameter of high and low pressure cylinders, 12 and 22 ins.; diameter of water plunger 11 ins.; stroke, 18 ins.; daily capacity, 1,200,000 galls. There is also a steel tubular boiler 16 ft. long, 54 ins. diameter. At a capacity test nine streams, 1-in. to 1⅝-in., were thrown to a height of 90 to 115 ft. and six more streams could have been thrown. The reservoir contains, when full, a supply sufficient to maintain 6 streams for 14 hours. There are 9.71 miles of 4 to 14-in. pipe. The Water Commissioners are J. F. BARTLETT, M. A. WARD, and WILLARD E. EVERETT.

Easthampton, Mass.—The Water Committee gives in its annual report some information obtained by E. C. DAVIS with regard to the amount of water which could be utilized for domestic purposes by collecting the different springs issuing from the side of Mount Tom at the level of the table land directly under the steepest part of the mountain, and above the highway leading towards Holyoke. This table land is about 345 ft. above the level of the springs forming the sources of Rum and Brandy brooks. The average flow of these brooks from August to November was 82 galls. per min., while all that could be readily gathered on the table land was 11½ galls., which amount was not considered sufficient, in view of the expense of a reservoir and connections, to warrant the town in adopting that plan for a water supply.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

(CONTINUED FROM PAGE 526).

Washington, Pa.—The works were commenced in June, 1887, and are now nearly completed; they are to be in operation by Aug. 1. They were designed by R. H. WILSON, and JAMES MCCULLOUGH, Jr., is Consulting Engineer. The contractors are: for pumping machinery, Deane Steam Pump Co., of Holyoke, Mass.; for pipe and specials, Warren Foundry & Machine Co., of New York, and the Scottdale Foundry, Scottdale, Pa.; for valves and hydrants, Holyoke Hydrant Co.; for reservoir, Coon & Co., of Washington, Pa. The supply is taken from Chartiers creek and pumped to reservoir direct from the filtering wells by a duplex pumping engine of 3,000,000 galls. daily capacity. There is a gathering reservoir of 13,000,000 galls. capacity, and a distributing reservoir of 3,000,000 galls. capacity. There are 26 miles of pipe and 40 hydrants. Ordinary pressure, 80 lbs.; fire pressure, 90 lbs. Cost of works, $325,000; debt, $75,000; rate of interest, 6 per cent. Annual revenue from city, $2,000. The franchise is perpetual and the hydrant rental is $50 each per year. The works are owned by the Citizens' Water Co., which is controlled by the Kittaning Consolidated Water Co. President, SAMUEL HAZLETT; Secretary, GEO. H. FOX; Treasurer, WM. POLLOCK; Superintendent, G. H. Fox. The capital stock, is $250,000, and mortgage bonds for $75,000. The present population is 13,000.

Ocala, Fla.—The works were commenced Dec. 1, 1887, and are to be completed by July 1, 1888; they are about completed. The contract for construction was awarded to the Jeter & Boardman Water & Gas Association, of Macon, Ga.; the pumping machinery was furnished by H. R. Worthington, of New York; the pipe, specials, valves, hydrants and tank by R. D. Wood & Co., of Philadelphia, Pa. The supply is drawn from an artesian well and pumped to a tank 25 ft. by 30 ft. on a brick tower 40 ft. high, by a duplex high pressure pump of 800,000 galls. daily capacity. There are 5¾ miles of pipe, 60 hydrants and 94 taps. The mains are of cast-iron and services of galvanized iron. Ordinary pressure, 60 lbs. Cost of works, $78,000; debt, $35,000; rate of interest, 6 per cent. Annual revenue from city, $3,000. The franchise is for 25 years, and the hydrant rental $50 per annum. The works are owned by the Ocala Water Co.; President, A. D. SCHOFIELD; Secretary, R. L. ANDERSON; Treasurer, A. E. BROADMAN. Capital stock $50,000; bonds, $35,000. Present population, 4,000.

(TO BE CONTINUED).

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water-supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

SPRINGFIELD, Mass., June 25, 1888.

EDITOR ENGINEERING NEWS:—The construction of the Barre, Vt., water-works was begun by us to-day. There will be 11 miles of pipe, 17,000 ft. of which will be a 16-in. main. The works are on the gravity system.

GOODHUE & BISBEE.

We also learn from the President of the Barre Water Co., J. HENRY JACKSON, that the source of supply is the STEVENS Branch of the Winoski river, that the works will be finished in the fall at a cost of about $50,000. EDW. W. BISBEE is Secretary, and WM. GOODHUE, Treasurer of the company. Population, 5,000.

BENSON, Minn., June 23, 1888.

EDITOR ENGINEERING NEWS:—We are drilling for an artesian well and expect to get a flow at about 1,600 ft.

R. P. JOHNSON.

BROOKLYN, O., June 23, 1888

EDITOR ENGINEERING NEWS:—The village proposes to let contracts for water-works on or before July 3. A supply is already taken from the Cleveland water-works, but this will be extended, making the total cost of the works $12,000, which will be paid by village bonds. The works will be finished Aug. 1. Population, 3,500.

H. M. FARNSWORTH, 219 *Superior St., Cleveland, O.*

LIGONIER, Ind., June 23, 1888.

EDITOR ENGINEERING NEWS:—The village proposes to build water-works, taking its supply from a well and pumping it to a tank. The works will cost about $15,000 and money for their construction will be raised by issuing bonds. C. E. ELLIS is President of the Water-Works Trustees and W. E. HINSDALE is Designing Engineer. Contracts will be let in July. Population, 2,500.

J. H. HOFFMAN.

SPARTANBURG, S. C., June 25, 1888.

EDITOR ENGINEERING NEWS:—We want water-works very much and have made two contracts for the same, but for some unknown cause the contracts have not been carried out. I think a good contract could now be made.

J. M. ELFORD.

PINEVILLE, Ky., June 22, 1888.

EDITOR ENGINEERING NEWS:—The projected water-works, for which surveys are now being made, will be built at once. The supply will be obtained from mountain springs collected in a reservoir several hundred feet above the village, and conveyed thence by gravity. If necessary, a supplementary force can be had from the river, by pumping. The gravity system will cost $25,000, and will be built by a private company of which F. A. HULL, Danbury, Conn., is President. Population, 500.

J. S. RUY, *Prest. Pineville Mt. Iron and Coal Co.*

UNION GROVE, Wis., June 22, 1888.

EDITOR ENGINEERING NEWS:—The Union Grove Stock Co., hope to put in a system of water works at a cost of $7,000. Water to be pumped to a tank from an artesian well already in use. JNO. ROCHE, is President, and A. P. COLBY, Secretary of the Company.

C. H. THOMPSON.

ELLENSBURGH, WASH. TER., June 18, 1888.

EDITOR ENGINEERING NEWS: A gravity system of water-works is now being built by the Ellensburg Water Co., the supply being taken from Wilson creek in the Cascade mountains, and conveyed to a reservoir. The works were begun May 1 and will be partially completed July 1. The cost will be $20,000. B. E. CRAIG is President of the company, and W. P. MASON, Engineer. All pipe is to be furnished by the Puget Sound Pipe Co. Our population is 2,000.

S. W. BARNES. *Secy. Board of Trade.*

REDDING, Cal., June 15, 1888.

EDITOR ENGINEERING NEWS:—The Redding Water Co. has pumped its supply by steam during the past year, forcing the water to a reservoir at an elevation of 56 ft. The company is now putting in a water-wheel supported on pontoons. S. P. FILLMAN can give further information. Our population is about 3,000.

B. F. ROBERTS.

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AND

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NOTICE.—We will pay 25 cents each for copies of September 10 1887 ENGINEERING NEWS.

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Bids or proposals for furnishing and delivering and laying 48-in. cast-iron pipes and their appurtenances from 135th Street and Convent Avenue, to the proposed Gate-House in the Central Park Reservoir, and doing all other work in connection therewith necessary to complete Section 16 of the New Aqueduct, as called for in the approved forms of contract and specifications on file in the office of the Aqueduct Commissioners, will be received at this office until Wednesday the 9th day of May, 1888, at 3 o'clock, P. M.; at which place and hour they will be publicly opened by the Aqueduct Commissioners, and the award of the contract for doing said work and furnishing said material, will be made by said Commissioners as soon thereafter as practicable.

Blank forms of said approved contract and the specifications thereof, and bids or proposals and proper envelopes for their enclosure, and forms of bonds; and also the plans for said work, and all other information can be obtained at the above office of the Aqueduct Commissioners on application to the Secretary.

By order of the Aqueduct Commissioners.
JAMES C. SPENCER,
President.
JOHN. C. SHEEHAN,
Secretary. 17-2t

Office of the Board of Sewer Commissioners,
PAWTUCKET, R. I., April 23, 1888.

Proposals for Sewer Pipe.

Sealed proposals will be received at the above office until 2 o'clock, P. M., Tuesday, the 8th day of May, A. D., 1888, for furnishing about five thousand (5,000) feet of sewer pipe, from six (6) to eighteen (18) inches in diameter, including the necessary specials. To be delivered F. O. B. cars at Pawtucket, subject to the regular city inspection. Delivery to be in car load lots.

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Report of the AQUEDUCT Commissioners.

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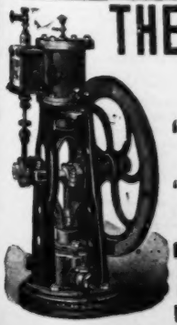

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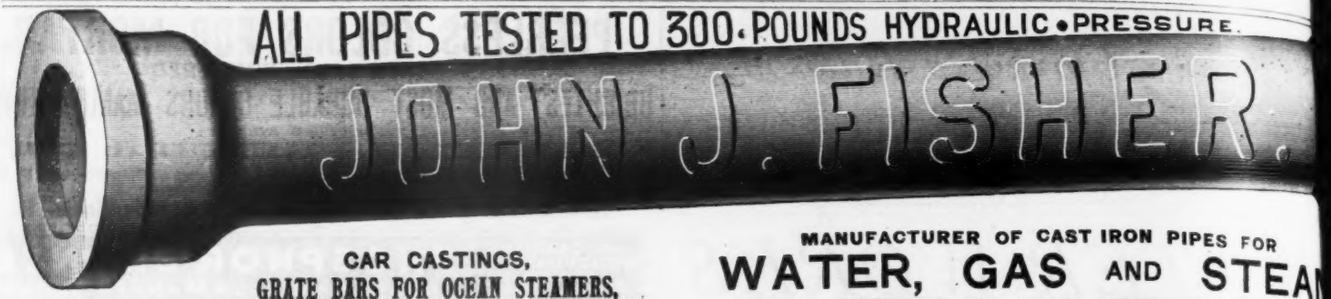

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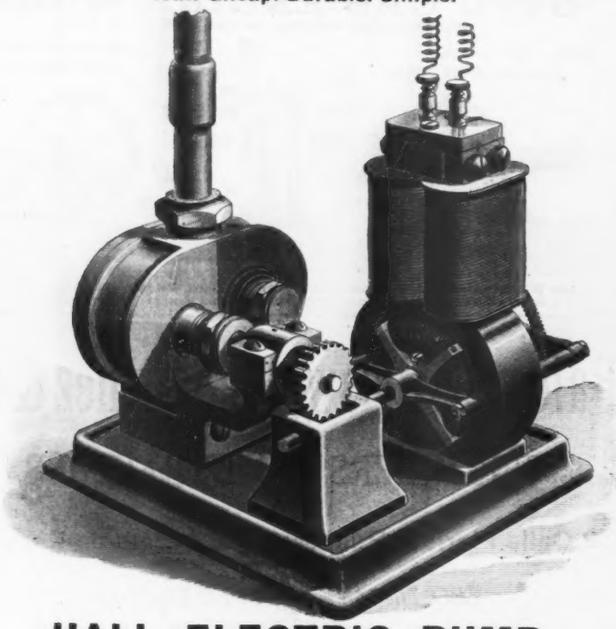

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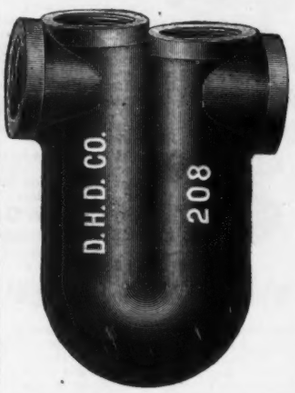

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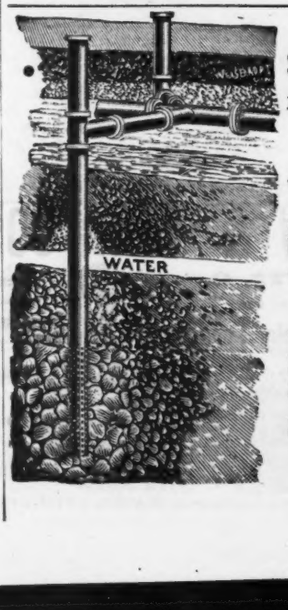

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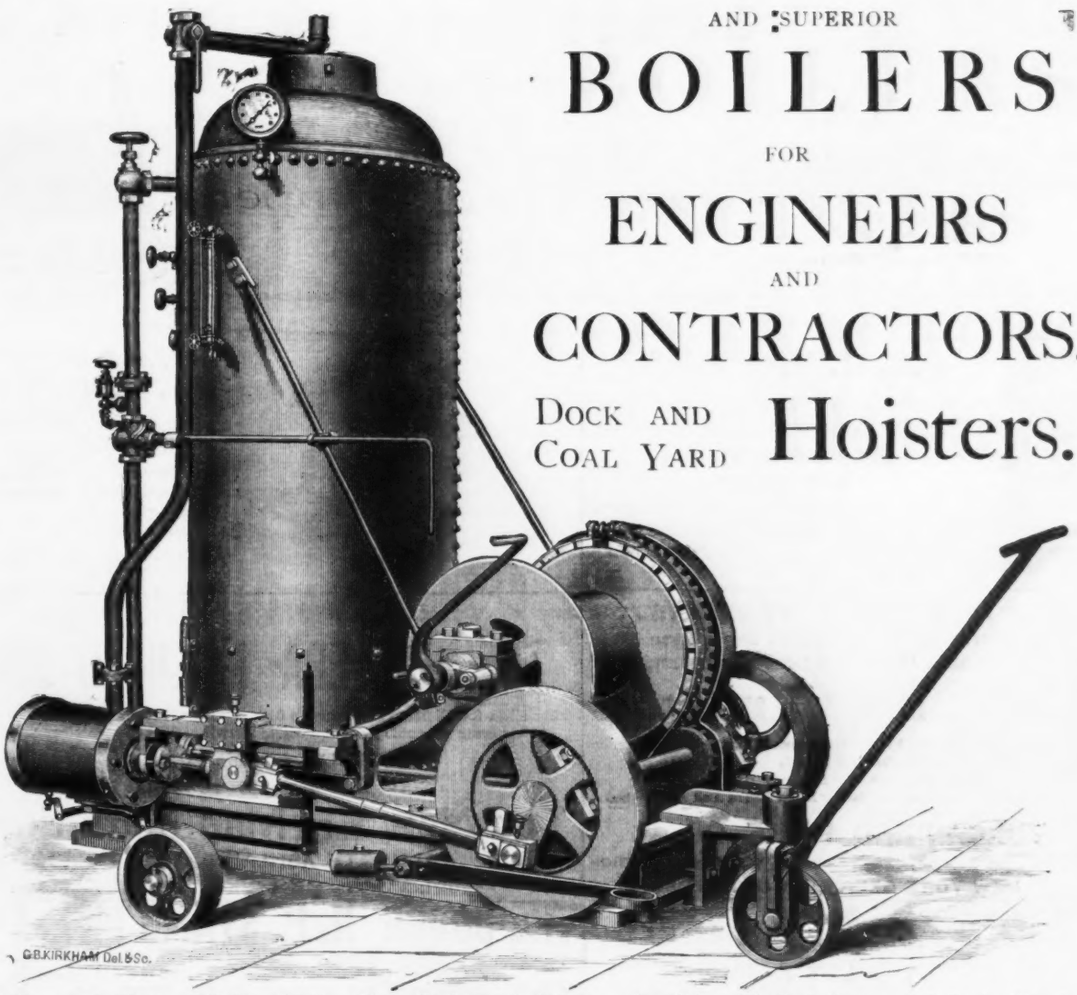

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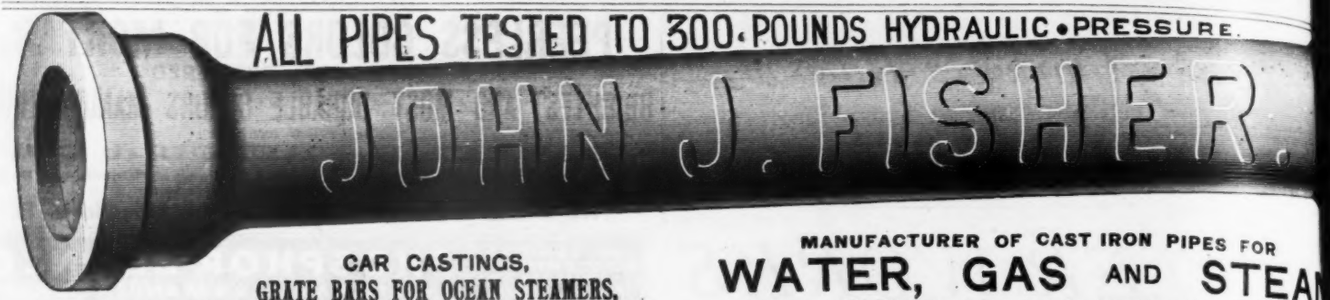

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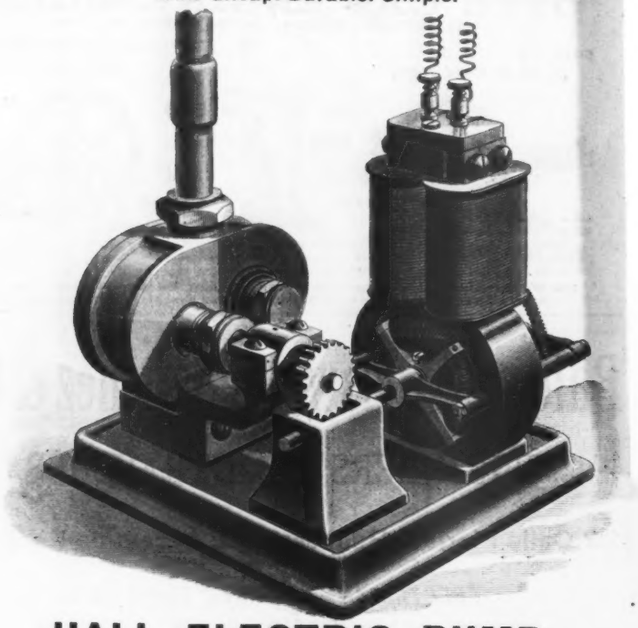

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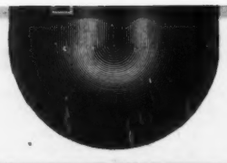

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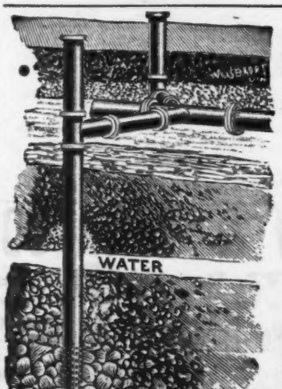

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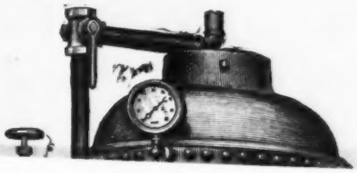

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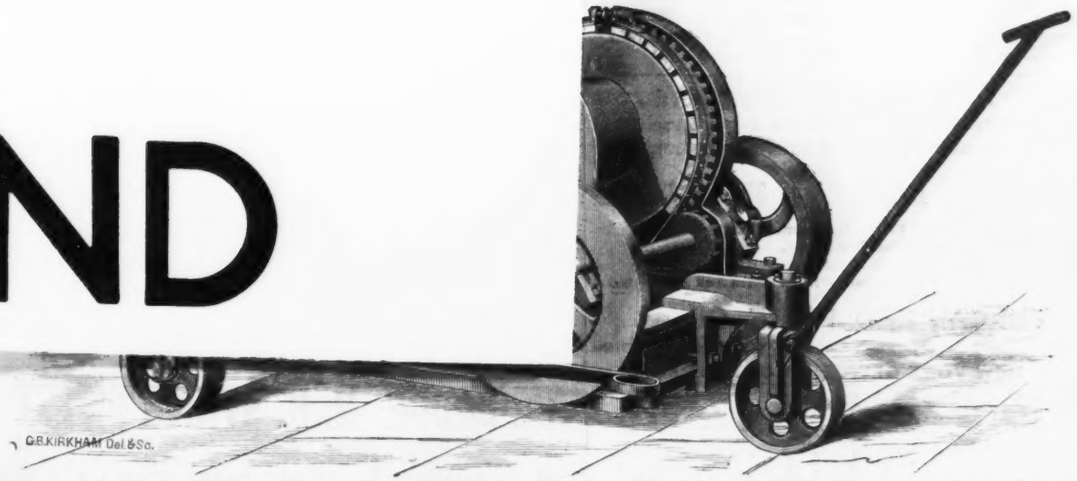

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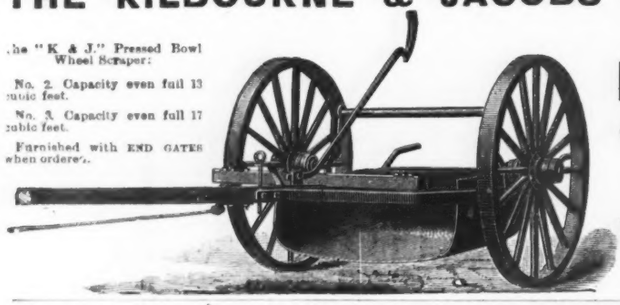

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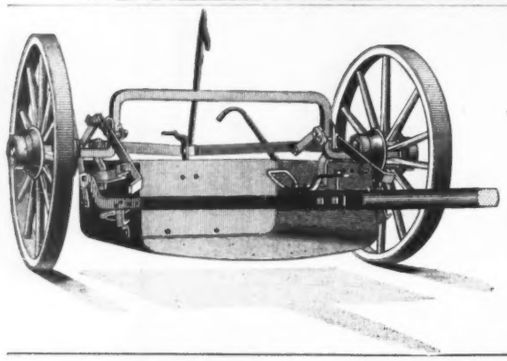

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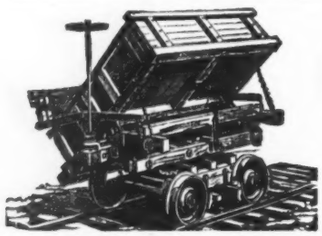

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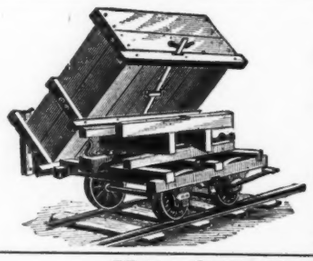

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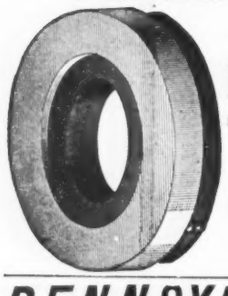

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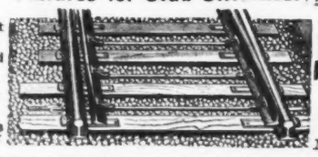

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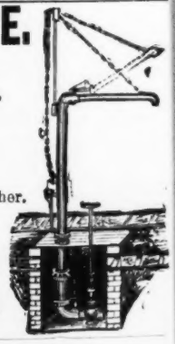

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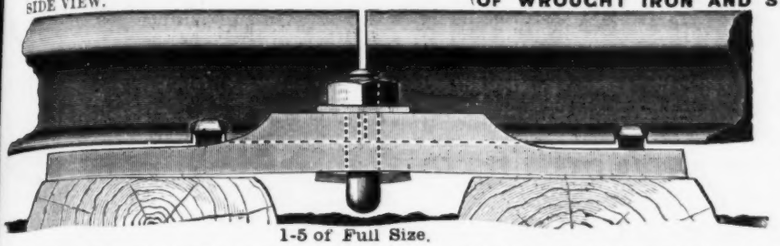

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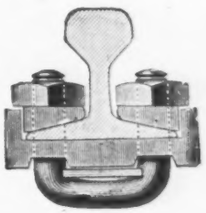

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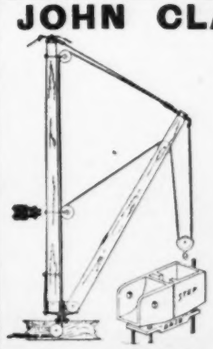

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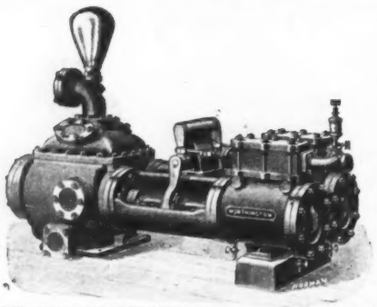

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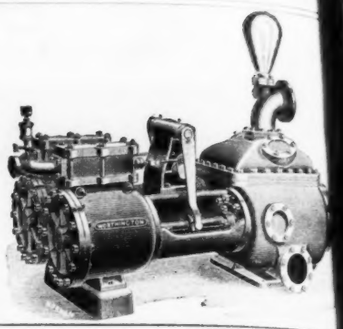

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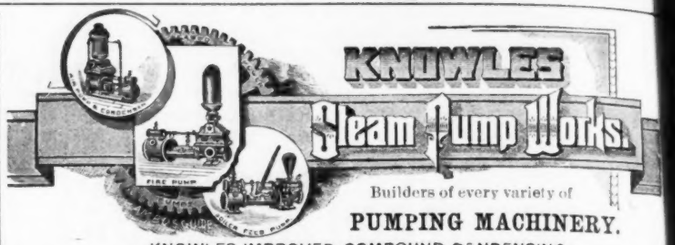

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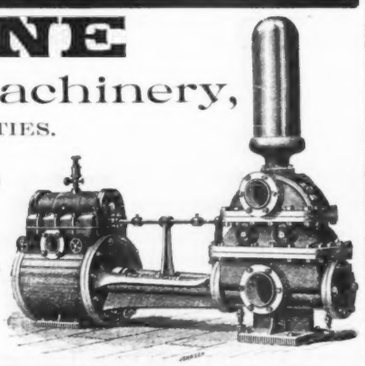

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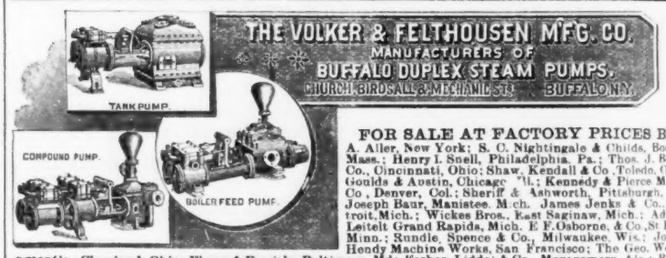

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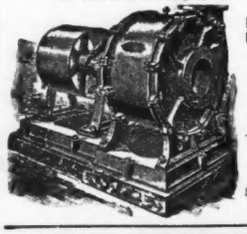

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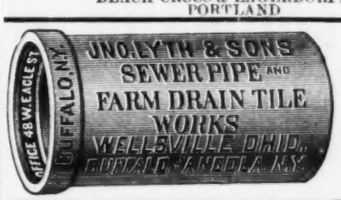

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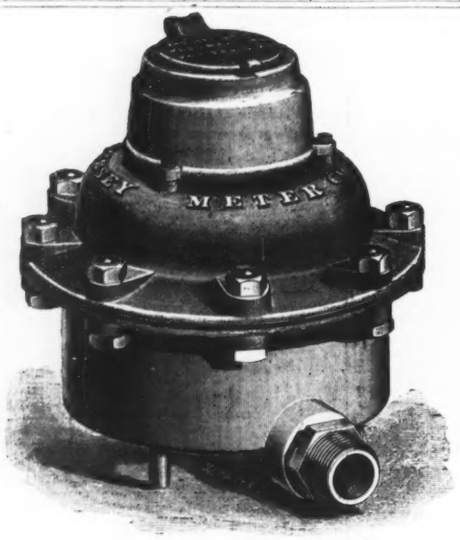

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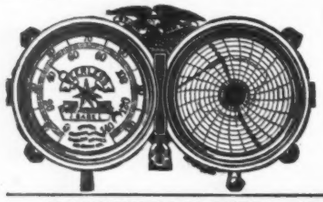

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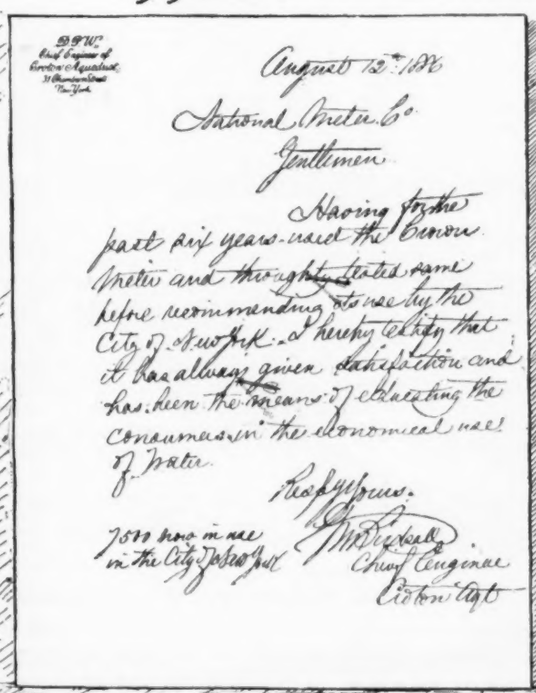

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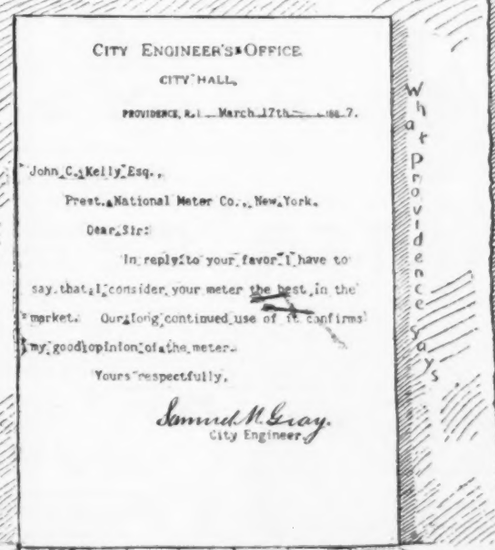

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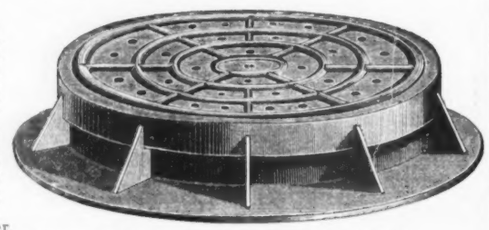

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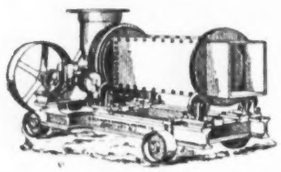

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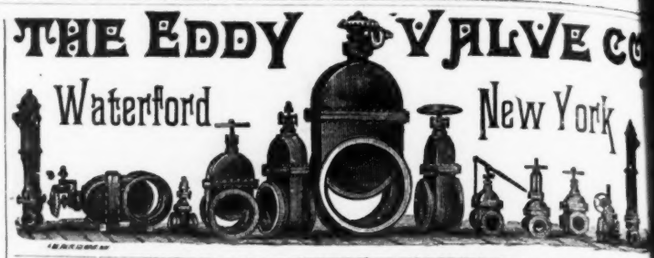

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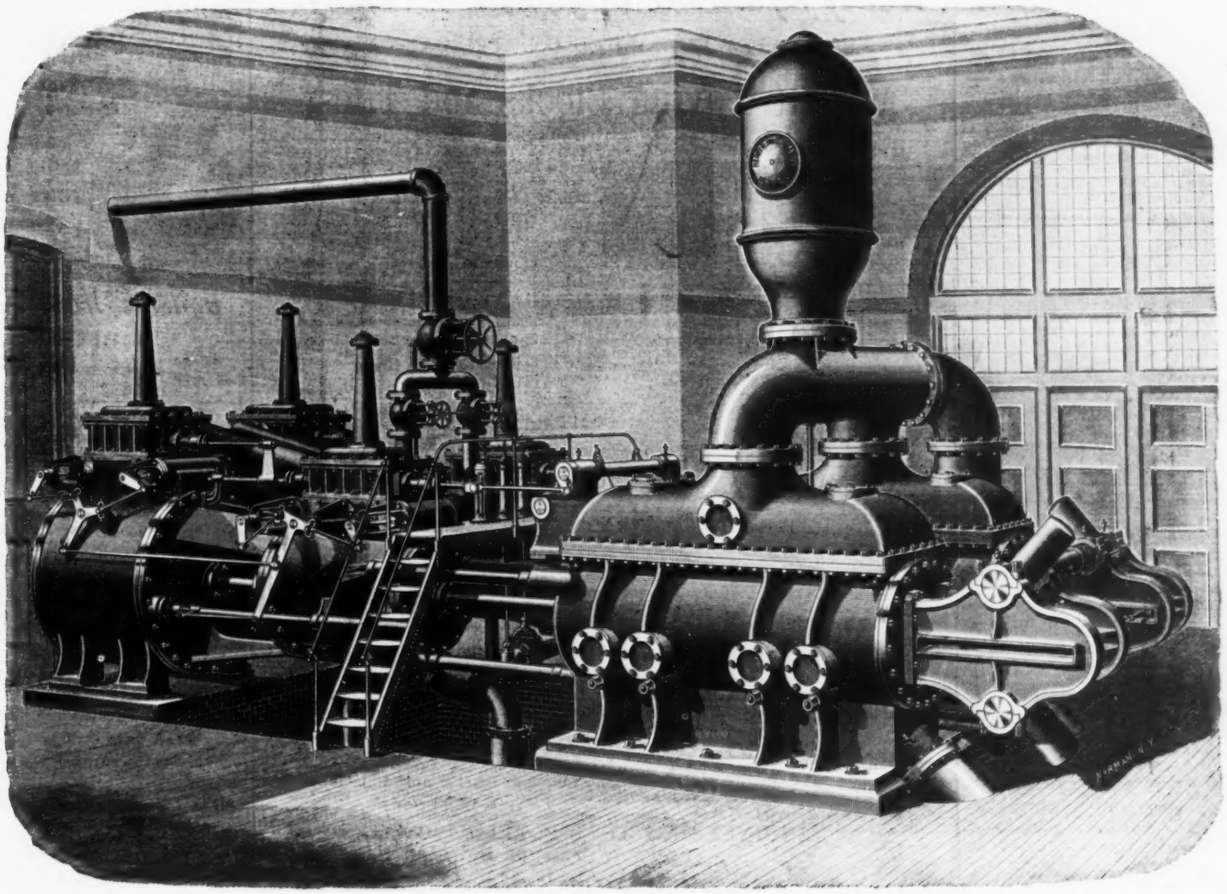

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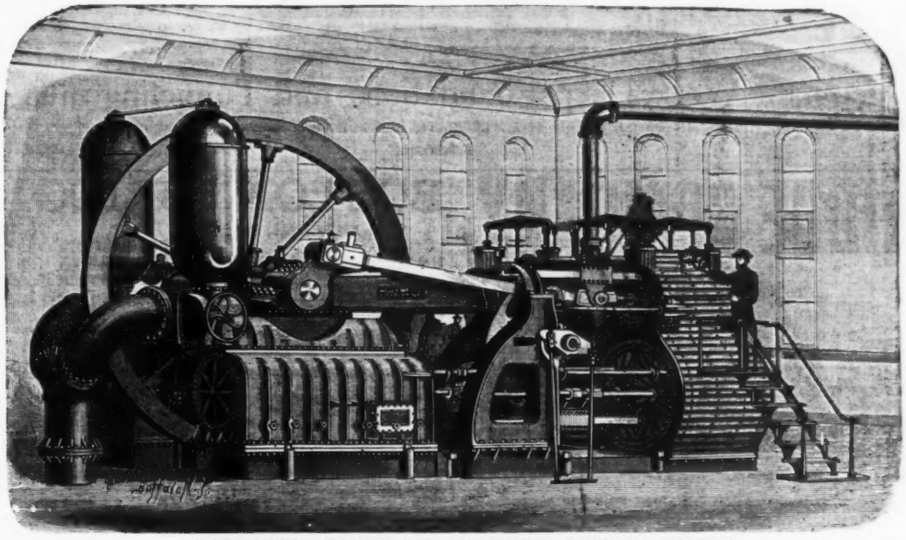

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1884	Omaha, Neb.	5,000,000	102,000,000	J. D. Cook, C. E., Toledo, O.
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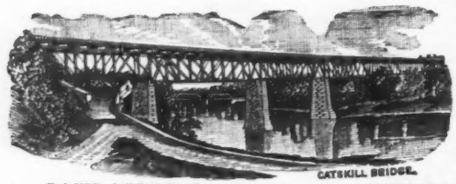
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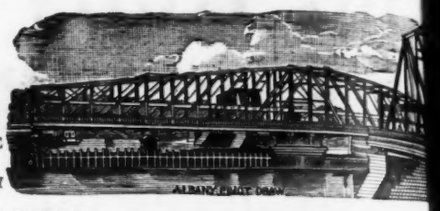
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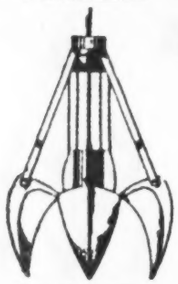
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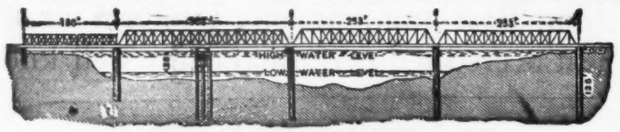
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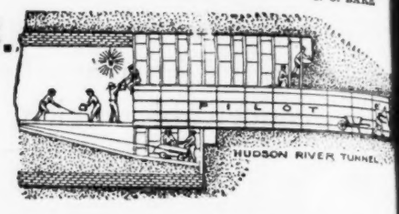
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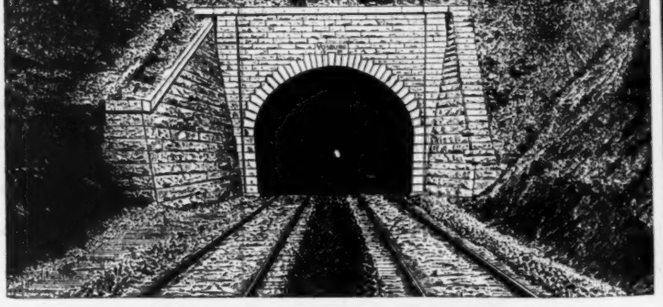

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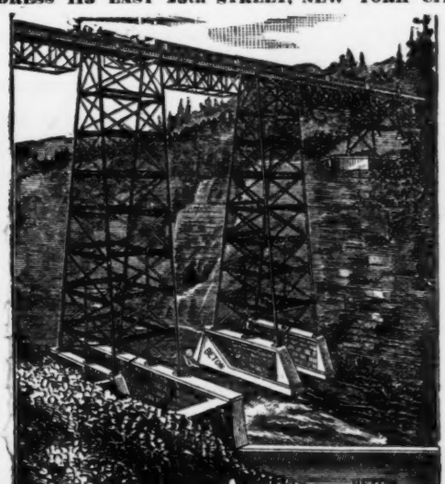

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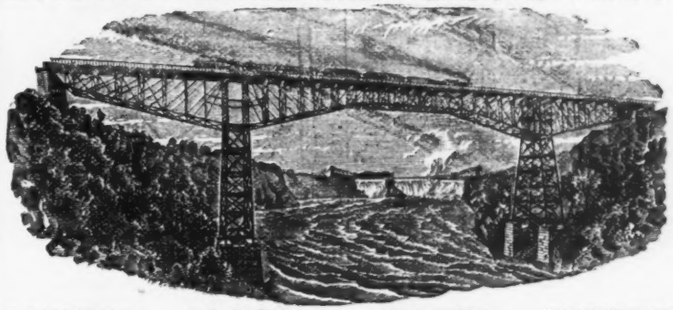

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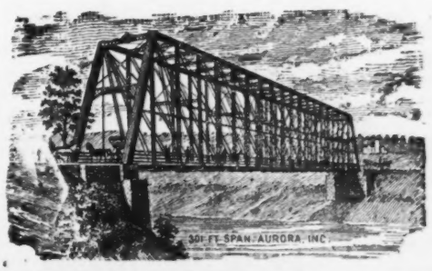

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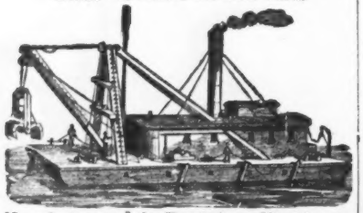

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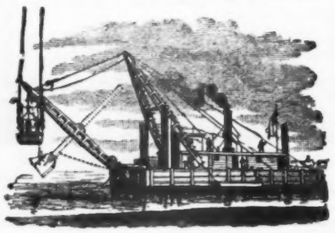

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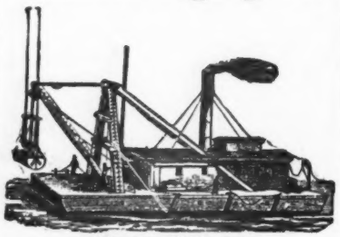

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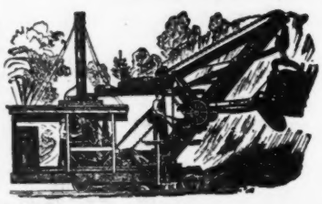

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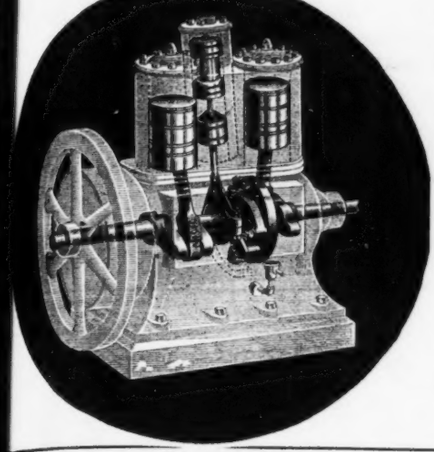

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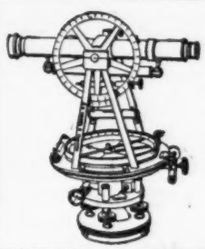

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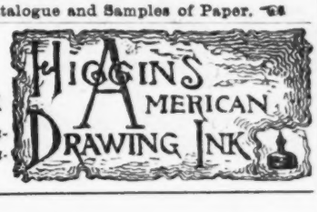

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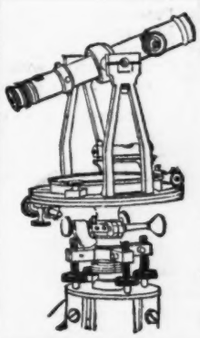

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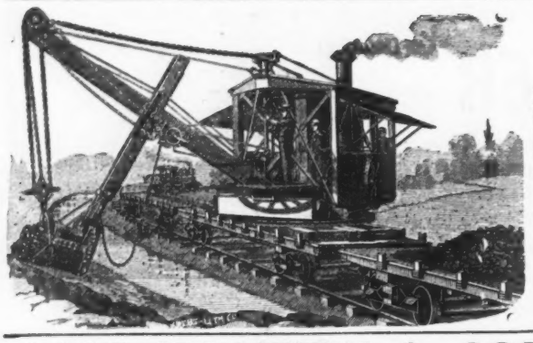

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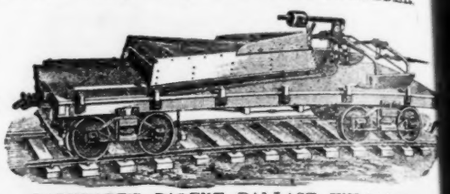

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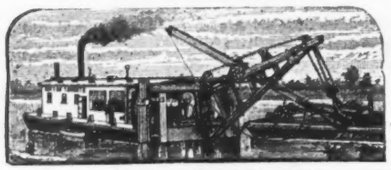

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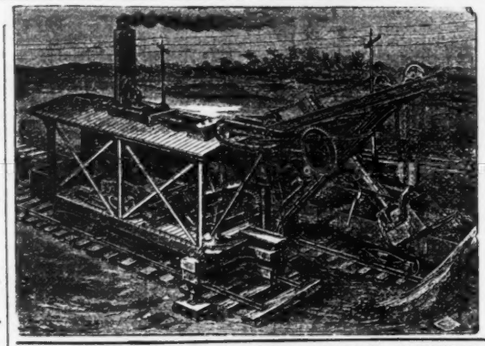

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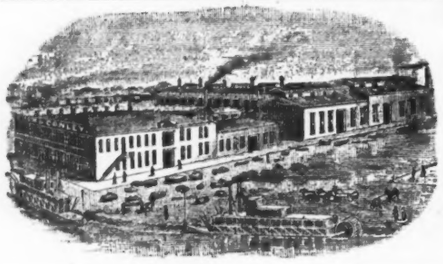

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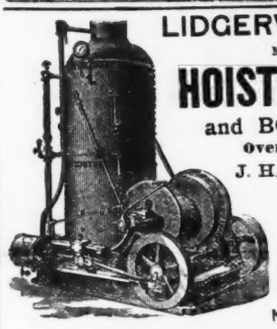

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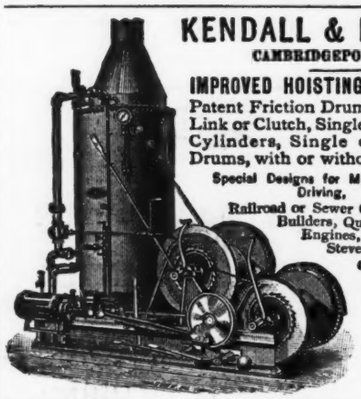

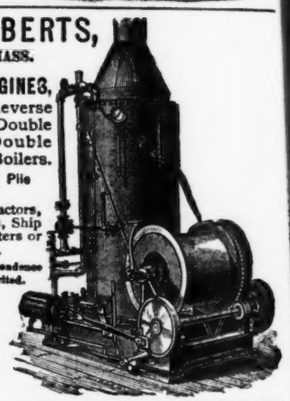

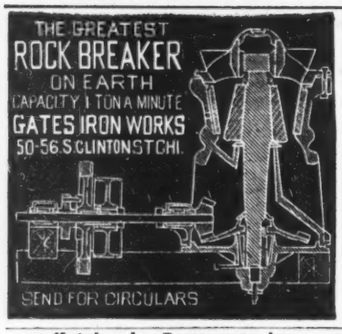

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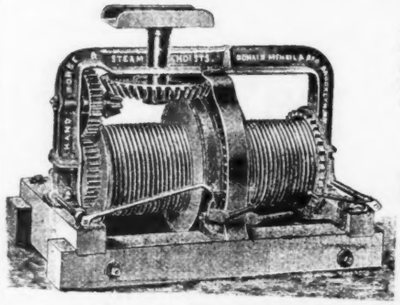

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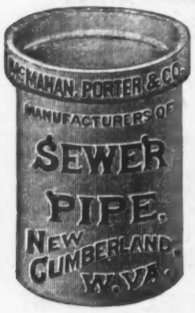

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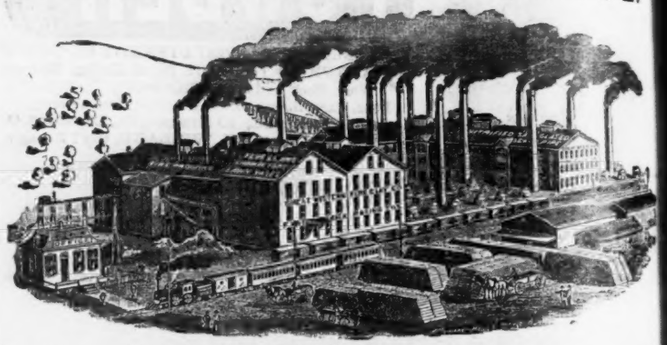

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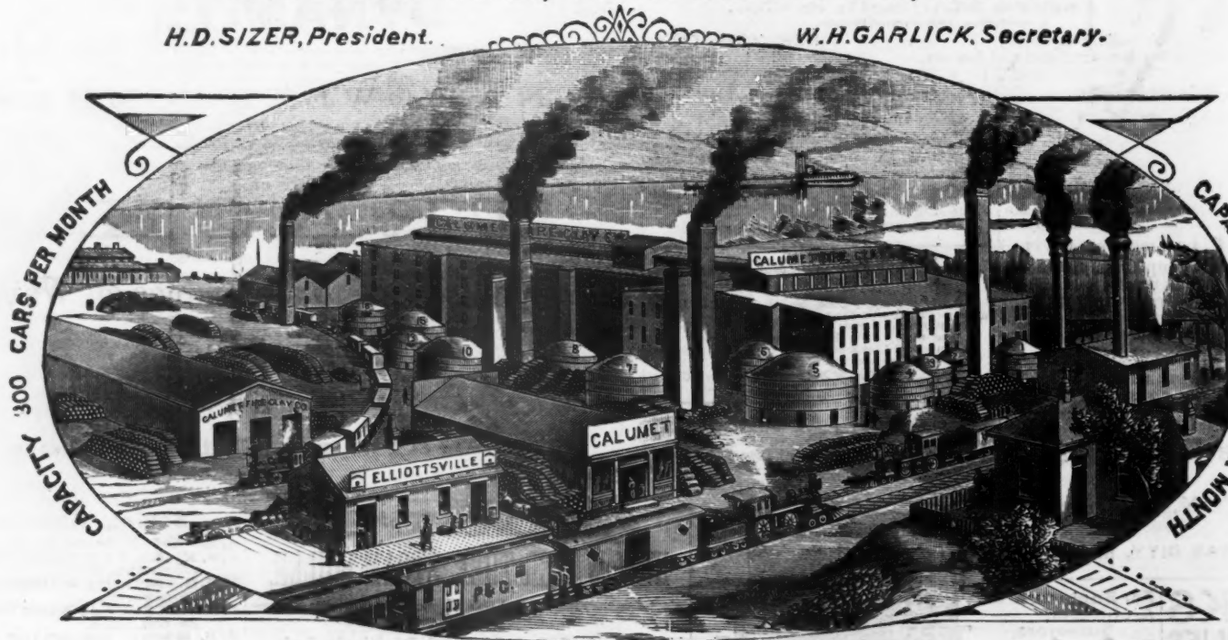

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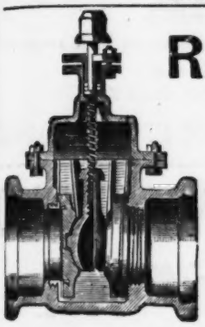

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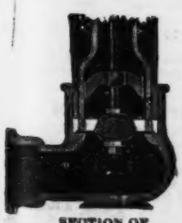

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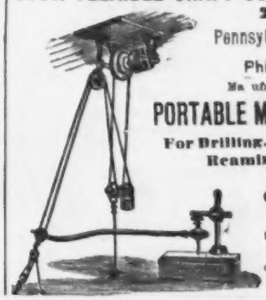

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